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CONTENTS.

EDITORIAL: PAGE
Paragraphs ... 443

ILLUSTRATED ARTICLES:
The Buffalo Fire Signal System ... 445
Close Speed Governing in Electric Railway Service ... 446
Illuminated Fruit Basket ... 446
The Relative Hardness of Various Kinds of Electroplating ... 446
Speed of Electric Cars in City Streets, by Chas. Hewitt ... 447
Electricity in Mining.—IV ... 448
Alternate Current Ohmmeters, by J. Swinburne ... 451
A New Alternator ... 452
Threading Rod for Underground Conduits ... 452
Lightning Guard for Electric Light Installations ... 453
A New Electric Carriage ... 453
The Columbia Motor ... 454
Improved System of Belting ... 454
A Porcelain Cleat ... 454
The Electrical Specialty Company's New Arc Light Cut-Out ... 454

MISCELLANEOUS:
Latest Foreign Electrical News ... 444
Elements of Practical Electricity, by Dr. Louis Bell ... 444
A Four-Year's Course in Electrical Engineering at Columbia College ... 445
The Supply of Gutta Percha ... 445
Four Electrical Libraries Secured ... 447
Safety Devices in Electrical Work, by Charles Wirt ... 448
History of Electricity, by P. F. Mottelay ... 449
The Thermal Emissivity of Thin Wires in Air, by W. E. Ayrton and H. Kilgour ... 450
For a Christmas Present ... 452
Lighting a Room with Reflectors ... 452
The Paris Electric Underground Railway ... 453
Additional Facts Concerning Major Bessol's Early Electric Railway, by A. M. Tanner ... 453
Electrical Affairs in St. John, N. B. ... 454
Newmarket Assembly Rooms ... 454
There Was a Bug on the Quad ... 455
The Ticker War on the New York Stock Exchange ... 455
Government Control of Telegraphs, by A. R. Foote ... 455

FINANCIAL INTELLIGENCE: The Electrical Stock Market, 456; New Incorporations, 456; Affairs of the Companies, 456.

SPECIAL CORRESPONDENCE: New York Notes, 456; Philadelphia Notes, 456; New England Notes, 457; Western Notes, 457; Southern Notes, 457; Canadian Notes, 457; English Notes, 457.

NEWS OF THE WEEK: The Telegraph, 458; The Telephone, 458; The Electric Light, 458; The Electric Railway, 458; Legal Notes, 459; General Applications of Power, 459; Educational Notes, 459; Personals, 459; Miscellaneous Notes, 459.

INDUSTRIAL AND TRADE NOTES ... 459

BUSINESS NOTICES ... 460

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS ... 460

The Heating of Wires.

NO subject has more afflicted the theoretical investigator and the practical electrician than the heating of metallic conductors by the electric current. The heat developed by a given current may be very exactly calculated, but its final distribution and the rise in temperature of the wire are things that differ so widely under varying conditions as to call for constant and untiring investigation. In our columns this week will be found an abstract, communicated by the authors, of a valuable experimental paper read before the Royal Society by Prof. W. E. Ayrton and Mr. H. Kilgour. Their research dealt with the determination of the emissivity of wire of small diameter, that is, its power of getting rid of heat through its surface, and took up with special care the variation of emissivity with diameter, a part of the subject of much practical use. For there are many cases when the relation of permissible current density to the size of wire used is of great importance, and any addition to our knowledge of the facts is a subject for congratulation.

Electrical Stocks.

IT is pleasant to be able to note the apparent increase of public confidence in electrical investments. Of late a considerable number of prominent capitalists have, after some deliberation, invested in new and old electrical enterprises. Well known financiers, in other words, are not steering as clear of electrical industries as they were disposed to do two years ago, or even less. These signs of confidence on the part of capital are really much more encouraging than dividends or beautifully rounded balance sheets, for the former bespeak a deliberate belief in the genuineness of the latter. Nothing can lie more adroitly and successfully than figures when used with intent to deceive, and nothing is easier than for two persons to take the same balance sheet and draw diametrically opposite inferences from it. Dividends, too, are not invariably paid out of legitimate earnings, for it is possible to juggle with accounts so as to present to the public a balance sheet showing a heavy surplus when the organization is just falling into the waiting hands of a receiver. But when responsible business men come forward, as many of them have been doing recently, and invest their reputations as well as their dollars in electrical companies of various sorts, it inspires a certain feeling of security that is most encouraging to those who are spending their lives in developing the electrical arts and industries. As the electrical business settles down to more and more stable lines and is conducted on more conservative principles than in the early days of exploitation, this confidence will be strengthened, and it will become easier and easier to secure money for legitimate work, not in the hope of enormous dividends at considerable risk, but in the certainty of fair and regular returns for the investment. Probably many vicissitudes will overtake things electrical before they acquire the established character that only comes with years, but in spite of cases of exaggerated capitalization, gloomy rumors set afloat through business rivalry, and occasional disasters, the electrical securities on the whole seem to have a better character with the financial public than they have had at any previous period of their history.

A New Magnetic Substance.

A NOTE in our cable dispatch this week contains a bit of information that bears in a very interesting way on our theories of magnetism. This is a discovery by Prof. Dewar that liquid oxygen is in a very marked degree magnetic. One of the most singular facts with which the physicist has to deal is that of all the substances with which he is acquainted only three—iron, nickel and cobalt—possess magnetic qualities in any noticeable amount. Many metals are slightly magnetic, but aside from the trio just mentioned—remarkably allied in chemical as well as in magnetic properties—there are none which would be classed as magnetic by the ordinary observer. It has several times been suggested that possibly at other temperatures new magnetic metals might appear; for it is known that iron, nickel and cobalt become non-magnetic at a moderately high temperature, about a dull red heat, so that if we could imagine a world in which the inhabitants were wonted to live at such a degree of heat, they would not be possessed of any magnetic metals at all and consequently would be seriously embarrassed in all electrical operations. Going in the other direction, toward extreme cold, it is well known that metals become far better conductors, and also that there are signs of increased magnetic properties. Prof. Dewar's investigations, however, struck out along a new line, for oxygen although slightly magnetic as a gas, would hardly be supposed—being non-magnetic in any ordinary sense—to acquire strong magnetic properties at any temperature, but it does. And here is really the puzzling, and also the encouraging part of the phenomena, for the ability to experiment with a gas which on condensation to a liquid becomes strongly magnetic may lead to some important discoveries regarding the character of magnetism and the purely molecular structure that gives magnetic properties. So far as we have to deal with magnetism in solids, the question of its relation to the molecule, in other words its specific nature, is very difficult of solution; it does not become altogether easy even when we can deal, as in the case of oxygen, with molecules under widely varying conditions, but the subject is under such conditions rendered a little more easy of approach both theoretically and experimentally. It is to be hoped that Prof. Dewar will continue his admirable work on this interesting topic.

A Problem for Inventors.

IN a short time the United States government is to undertake trials of automobile torpedoes that possess, aside from their importance in military circles, a decided interest for electricians. The torpedo has become an important part of both military and naval equipment, and although—thanks to the good fortune that has preserved society from extensive wars since the development of torpedo service—there has as yet been no opportunity for observing its effects on a large scale, it can hardly be denied that the torpedo has come to stay both as a weapon of defense and offense. Such being the case it is not out of place to call the attention of electrical inventors to the subject. As is well known to most of our readers, automobile torpedoes are of two classes, the first simply projectiles aimed and fired with more or less accuracy—generally less—from short torpedo tubes; the second composed of dirigible torpedoes, of which the Sims-Edison is perhaps the most familiar. There are, however, several others in various stages of development, and so far as has appeared the ideal instrument of destruction has yet to be invented. In other words there are serious difficulties encountered, perhaps the most formidable being the securing of proper insulation in cables which are to be paid out behind the torpedo to furnish a supply of power. A good many experiments, and successful ones, have been tried with the Sims-Edison and other forms, but for the purpose of torpedo warfare it is not enough that a dirigible torpedo should be capable of effective operation, it must be almost certain in its results. Furthermore, the speed must be very great in order to permit of successful service. Roughly speaking the following conditions have to be met: First, certainty of action; second, high speed, say 25 miles an hour or thereabouts; third, perfect control, and fourth, reasonably long range. All the dirigible torpedoes as yet devised satisfy one or more of these conditions well and others with less success. The general character of the design has embodied in each case electricity as a motive power, or simply as a means of control or both. In the former case it has been applied either directly from the shore to a motor on the torpedo, or by a storage battery in the torpedo controlled from the shore. Other plans have embodied motive power other than electricity, generally either compressed or liquefied gas and steering apparatus electrically controlled from the shore. With the interest that is at present taken in the development of our military and naval resources, the field is a very good one for inventors, and a careful watch on the result of the experiments that are from time to time tried will doubtless give many a good hint for improvement, both to those who are already interested in such apparatus and to those who are alert to profit by the experience that has been gained.

Electric Street Car Speed Tests.

WE publish this week an exceedingly useful and instructive study of the speed attained on electric street railways. It is the first time such a record has ever been made public, and its results are therefore doubly important. As will be seen by reference to Mr. Hewitt's admirable article, the cars tested were a long double truck affairs of the type which has now come into considerable use on electric roads. They were fitted with two single reduction Edison motors, one upon each truck. Not only was a most accurate record of speed taken by means of the Boyer speed recorder adjusted for that purpose, but a very careful estimate was made of the load, and readings 15 seconds apart were taken of the electrical output, so that not only do the diagrams show the speed obtained but afford a ready means of obtaining the approximate efficiency of the motors. The ampères taken by each motor were measured individually, so that the distribution of work between the two, as well as the total work performed, is shown. In the single reduction gear machines the equalizer coils, employed on many of the old motors, have been abandoned, reliance being placed on careful construction to avoid any serious difference in load upon the two machines. The results of the test showed that the currents in the two, although not equal, yet did not vary from each other very widely. In this connection it ought to be remembered that an exceedingly slight difference in the magnetic properties of a pair of machines makes the most exaggerated difference in the current distribution, so that the three or four ampères variation noted corresponds to an exceedingly small actual difference in the properties of the motors. Glancing over the records obtained it appears that the highest speed reached was about 21 miles an hour, while the average speed was in the neighborhood of 10, giving a very wide margin for making up time. Even through the crowded part of the city where stops were made at practically every block to take on passengers the average speed maintained was nearly 10 miles an hour. This is an exceedingly satisfactory figure, considerably higher than would be supposed feasible even by street car men; it shows plainly enough that the eight-miles-an-hour limit so often insisted on through the old-fogyism of city councils is totally needless, for the cars tested were in regular service following the general schedule used on the road, and we are not aware that the records in Buffalo showed more accidents than are inevitable on street car lines in city or country. Between blocks the speed rose as high as 14 or 15 miles an hour, and the acceleration of the cars was very rapid. The diagrams make it clear that it is a mistaken idea to suppose that cars must be confined to a low speed, even in the city, while on every street car system there are long stretches where it is quite possible to average 14 or 15 miles an hour if necessary to make up a satisfactory schedule. As to the power required to maintain this speed with a normal load of passengers, a glance will show that it was not far from 14 electrical horse power during the regular trips. In one run as high as 20 h. p. was required for the given load and speed. On any reasonable hypothesis as to the co-efficient of traction, the mechanical power required was so far below the output necessary as to show that nothing material has been gained in point of efficiency by the use of single reduction motors. There is considerable yet to be learned about the designing of low speed motors, and the lower the intended speed, the more there is to learn. It will require very careful designing, both mechanical and electrical, to put the single reduction gear and gearless motors at that point of efficiency where they ought to be. But the great lesson to be learned from Mr. Hewitt's paper is that it is possible to operate electric cars, even in a comparatively crowded city, at a very decidedly higher speed than has generally been supposed, and therefore to give better service and carry more passengers than is usual. The speed record itself will bear close inspection, and teaches a valuable lesson, particularly as regards the desirability of stopping only at crossings; the public soon gets used to this method of operation, and it is more convenient in the long run for all parties concerned.

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

LONDON, Dec. 14, 1891.—Prof. James Dewar, of the University of Cambridge, has just placed an interesting communication before the Royal Society. In a research on liquefied gases, he has found that liquefied oxygen, obtainable at a temperature of 180 degrees Celsius below zero, is powerfully magnetic. That the gas is magnetic is a familiar fact, but the remarkable property of the liquid has heretofore gone unnoticed. It has been supposed that at very low temperatures metals ordinarily non-magnetic might acquire different properties, but the discovery of this fact regarding oxygen, which unlike hydrogen is not ordinarily regarded as of metallic character, is most interesting.

At the meeting of the Institution of Electrical Engineers on Thursday last, Prof. W. E. Ayrton, of the City and Guilds of London Central Technical College, was elected its president for 1892, an honor that had been well earned by Prof. Ayrton's important work extending over a long series of years.

Mr. W. H. Preece, at the same meeting, read a valuable paper on insulated conductors, and an announcement was made of a lecture to be delivered in January by Mr. Nikola Tesla, of New York, embodying the result of some of his recent researches. Mr. Tesla's paper on "Electrical Phenomena at Very High Frequencies," published in THE ELECTRICAL WORLD early in the past summer, attracted great attention on this side of the water, and his important work on alternating current motors has already made his name a very familiar one among practical electricians in Europe.

With the initiation of the first regular trolley line at Leeds has begun the difficulty with the telephone companies with which you in America are already acquainted. Although the line has been in operation less than a month, a complaint has been lodged against it by the National Telephone Company for interfering with the telephonic service.

The question of a standard of light is again before the public, and the Board of Trade is about to appoint a committee to deal with the subject. The last time the standard of light was considered important results were reached; but a somewhat impractical standard was advanced, and it is to be hoped the present committee will treat the matter in a way more satisfactory to practical men.

The municipality of Richmond has finally sealed its contract with Latimer Clarke Muirhead & Co. for an electric light plant and as an addition to the list of coming municipal plants. Nottingham has voted £30,000 ($150,000) for the electric lighting of that city.

The Elements of Practical Electricity.*

BY DR. LOUIS BELL.

MEASUREMENT OF ELECTRIC CURRENT.

We have already seen enough of the properties of the electric current to understand that we can measure it by means of various effects which it produces, its action in depositing copper from a solution, its power of heating wire, or its ability to exercise a certain pull on a magnetic pole. But in what units shall we count current? We measure water by quarts or gallons, and weight by pounds or ounces; in what terms shall we measure that something which we call electric current, and which one of its properties shall we take as a starting point in that measurement? As a matter of convenience we should evidently take for measurement some effect of electrical current that can be itself readily and accurately measured. Of the physical quantities weight is probably the handiest to determine exactly, and for this reason it is admirably suited to the purpose before us.

Delicate balances, such as are used in physical laboratories, can readily be made to determine the weight of a piece of metal weighing say a pound, to one ten-millionth part of its value, a degree of accuracy more than sufficient for electrical purposes. Now we cannot take a piece of electrical current and weigh it, but we can estimate in terms of weight both its chemical and its magnetic effects. We might, for example, put two copper plates in a solution of copper sulphate of known strength and pass through that solution the current we desire to measure, keeping it as nearly constant as possible; after an hour or so, or any exactly known time, in fact, we might take out the copper plate on which copper has been deposited from the solution, wash it carefully, dry it and weigh it. Having weighed it before immersion in the solution, the difference in its weight before and after the deposition of copper will give very exactly the amount of that metal which has been separated by the given current. This would enable us to compare currents very accurately, and if we should agree to call the current which deposited a certain amount of copper per minute our unit current we should be able to say, for instance, that one current was twelve units while another was four or five.

Or we might utilize the magnetic effect of a current and measure it by finding out how many grains pressure you would have to exert against the magnetic needle to equal the same force exerted by the current in question. This would be, experimentally, by no means as easy, but it could be done, and, as a matter of fact, is the method which has been taken for classifying electric currents; in other words, the unit current is said to be that current which flowing along a wire of unit length, curved so as to be all the time at unit distance from a unit magnetic pole, will produce a unit push or pull upon that pole. This can be ultimately measured in terms of weight. But how shall we define the unit magnet pole just mentioned? In a similar fashion a unit magnet pole is one which when placed at unit distance from another like pole will push it away with one unit of force, which again can be weighed by proper instruments.

This may seem a somewhat roundabout way of getting at unit electrical current, but it possesses the inestimable advantage that current so measured becomes comparable with other things which can likewise be weighed. It is this particular way of choosing units that enables us, for example, to measure in electrical terms the output of a given dynamo, and then to say that its output is at the rate of a certain number of horse power. In fact, for convenience it is necessary that units in which we measure all sorts of things should be connected to each other, so that we can compare one directly with another. In other words, it is necessary for practical use to have a system of measurement by which we can measure all sorts of things, the more sorts the better for our convenience.

UNITS FOR MEASURING PHYSICAL QUANTITIES.

Were we to trace any system of measurement down to its very foundation we should find three quite independent things of which we have to take account—length, mass and time. If you think it over you will see that these are three things which are totally distinct from each other, although we may bring them into more or less relation to each other. For instance, when we measure velocity we count it as so many feet per second or minute. In other words velocity is measured in terms of time and length. Work, the lifting of a weight, for example, through a certain number of feet, is measured in terms of length and mass, or weight, by which we ordinarily reckon mass.

Mass is really somewhat indefinable, being the thing which expresses the how-much-ness of a stone, for instance. Now the more simple we can make the relations between the three fundamental units of length, mass and time, by properly choosing those units the easier it will be to reckon quantities which have to be measured—like those just mentioned—by combinations of these fundamental ideas.

In our ordinary English measurements the second would be the usual unit of time, the yard is the established unit of length, and the pound of mass. The three are not conveniently related, however, for the yard is divided into three feet, each of which contains 12 inches, and the pound into 16 ounces, further subdivided into drachms and grains. If, for instance, we wanted to find out how much a cubic yard of water weighs, we should have to sit down and laboriously figure it out, having at hand certain numbers,—the weight of water in grains per cubic inch, for example—by means of which to make the computation. In fact, it is safe to say that it would be hard, even deliberately, to devise a system of weights and measures more disconnected, complicated, and inconvenient, than those in everyday use among English speaking people. It is a waste of energy to learn, a waste of brain power to employ, and only exists in virtue of true worn custom and stubborn disregard of improvements.

THE METRIC SYSTEM.

Now it happens that there is a very convenient general system of measurement which is in use to-day all over the world for scientific purposes in which the various quantities are related to each other in the simplest possible manner, so that calculations such as the above can be made in the head at a moment's notice. The electrical units are now a part of it. With this system of measurement you will have to acquaint yourself if you propose to arrive at any intelligent comprehension of electrical units, even those in everyday use. The system is based on the metric system of weights and measures formally authorized by the French government, almost exactly 90 years ago, in November, 1801. This was during the somewhat unsettled period that followed the French Revolution when that government was ready to upheave almost anything purely for the love of change.

Of the many things they changed, the system of weights and measures—wonderfully perfect and admirable—is almost the only change that survived. It was intended to be based upon the dimensions of the earth, and the unit of length was taken as one ten-millionth of a quadrant of the earth's circumference; as a matter of fact the value selected for this quantity was not absolutely accurate, but that made but little difference in the principle. This standard of length, approximately a forty-millionth of the earth's circumference, was called the metre and was divided into tenths, hundredths and thousandths, to furnish convenient units for small measurements and multiplied by 10,100 and 1,000 for convenience in large measurements. Fractions or multiples of the metre were designated by combining with the word "metre" a series of prefixes, which are as follows:

Prefix.		Meaning.
Micro—	means	One millionth.
Milli—	"	One thousandth.
Centi—	"	One hundredth.
Deci—	"	One tenth.
Deka—	"	Ten times.
Hecto—	"	Hundred times.
Kilo—	"	Thousand times.
Myria—	"	Ten thousand times.
Mega—	"	One million times.

The metre equals 39.37 English inches, and consequently its tenth, the decimetre, is a trifle less than four inches, and its thousandth, the millimetre, very nearly one-twenty-fifth of an inch. Of the multiples the one most often used is the kilometre—a thousand metres—which equals a trifle over three-fifths of a mile.

The unit of mass was intended to be derived directly from the unit of length, and in the following way: The unit mass was taken as the mass of one cubic centimetre of pure water at its temperature of greatest density—a little above the freezing point. This unit of mass was called one *gramme*, which equals 15.43 grains, a little more than a thirtieth of an avoirdupois ounce. This unit of mass is provided with multiples and submultiples by the use of exactly the same set of prefixes that were adopted for the metre; one milligramme, for instance—a little less than one-seventh of a grain—is the unit used for very small weights; one kilogramme—two and one-fifth pounds—is the standard weight used for everyday purposes. In this way the units of mass and length are united and the units of capacity and of surface are derived directly from those of length. For example, the unit of capacity is 1,000 cubic centimetres, called the "litre." Hence you will see that a litre of water weighs a kilogramme, for a cubic centimetre weighs a gramme. We have no time here to go at any length into this metric system, as you can look it up in any ordinary arithmetic, and you ought to do so.

THE C. G. S. SYSTEM OF UNITS.

For measuring derived quantities, besides the three fundamental ones originally mentioned, a system of units has been devised, taking this metric system as a starting point. It is sometimes called the "absolute" system, a name not particularly well chosen, but convenient because it has passed into ordinary usage. In this system the unit of length is the *centimetre*, the unit of mass the *gramme*, and the unit of time the *second*. All the other units are built up on these, including the electrical units, and consequently they are all comparable one with another. The whole set of units is frequently called the C. G. S. system, from the three initial letters of its fundamental units. Now, the most important derived units are those of velocity, acceleration and force. It is the latter, you will remember, that we are anxious to find out just now. Velocity we can understand readily, and unit velocity, under our present system, would evidently be one centimetre per second. Acceleration is the rate of change of velocity. For example, a body may be moving at one speed at one moment and at a different one a few moments later. A change of the velocity per second is acceleration, and unit acceleration is, then, a change of speed amounting to one centimetre per second. You will begin to see already how much simpler it is to take units derived from a consistent system than to set up a special unit of velocity—a mile a minute, for instance—and another one of acceleration 15 feet per second, as might be the case did we not start at the very beginning and build up the derived units in a systematic way.

Now, perhaps the most inherent property of matter is that it cannot give itself velocity, much less change of velocity. If it moves from rest, or is accelerated, it is because something has pushed it. If you leave a brick in a certain position and come back an hour later to find it has moved you are perfectly justified in assuming that something or somebody has done it. This property of matter, of stability, of being unable to move itself, is called inertia, and in physics that which causes acceleration in matter, or motion of any kind in fact, which must always begin with acceleration, is known as force. It is, perhaps, the hardest word in the language to define, unless in the particular way we have chosen, that is in terms of acceleration. Now, since force produces acceleration, it can be measured by it, and unit force is that cause of acceleration which produces—acting on a mass of matter equal to one gramme—a change of velocity of one centimetre per second.

This unit of force, unlike those of velocity and acceleration, has been given a name of its own, and is called the "*dyne*." Since weight is mass, that is, the quantity of matter in a body, under the influence of the force of gravity, we can readily get at the pull exercised by one pound or gramme of weight in terms of dynes. For instance, it can be found by experiment that when a body, of whatever sort, falls freely, that is undisturbed by friction of air or anything else, under the action of gravity, it is given an acceleration of 980 centimetres in each second. Therefore the weight of one gramme, measured as a pull—on the end of a balance arm, for example—is 980 dynes, or, roughly speaking, a dyne is the weight of a milligramme. We may now go back and apply these new and convenient units to the measurement of electrical quantities.

(To be continued.)

* Continued from THE ELECTRICAL WORLD of Dec. 12, 1891.

The Buffalo Fire Signal System.

The necessity for protecting a city or a large town from fire by the assistance of electric signal systems has become so universally recognized that there is scarcely a city in the United States which does not enjoy the advantages of such protection. Among this great number there are many of special interest which have not as yet claimed the attention of the electrical journals.

The city of Buffalo was the fourth city in the United States to adopt a fire alarm telegraph system. This was done in 1865, and commenced operations in June, 1866. The present headquarters of the department, at the corner of Court and State streets, is the third office which the department has occupied since its organization.

The illustration given herewith gives a good idea of the operating room of the system. All circuits running from call boxes to the main switchboard are protected by fuse wires designed to break the circuit in case of a cross with street car or electric light lines. Should this occur, the operator will be notified by an indicator whether the fuse wire has parted in the tower or in the basement where the underground wires come in. All the circuits are protected from lightning by arresters placed outside of the building.

The operating room contains two large switchboards 18 feet long. The lines after passing the lightning arresters run in ducts under the floor to the operating board. Board No. 1 contains, in the centre, 47 galvanometers and one large test galvanometer, all of a new pattern. To the right and left of these are arranged test switches for box, gong, and joker lines. Also devices for testing all lines automatically every thirty minutes. Above the marble slabs holding these switches are the numbers showing from what box or boxes signals are rung.

On the extreme right and left are groups of new pattern sounders, as well as looping-in keys for throwing in instruments to test and measure current on the lines. This can be done without opening the main lines from the signal boxes, and they are so constructed that there are no joints to work loose, or adjustments that can get out of order.

A system of Morse keys is arranged for telegraphing from the street boxes.

Above the looping-in switches are the main line relays inclosed in a beveled plate glass cabinet, and also the outgoing alarm relays. Above these relays are the ground detectors for showing the trouble on lines, and above these again are what are known as "Out-of-service annunciators," for showing what companies are out of quarters at a fire.

The registering instruments are connected with board No. 1, and are the well known A. C. Palmer perforating registers.

Nearly all the circuits of the system are run in cables underground. The entire cable equipment was supplied by the Standard Underground Cable Company, of Pittsburgh, of which Geo. L. Wiley, Times Building, New York, is agent, who seem to have made a specialty of this class of work.

The department is now in charge of Supt. Henry Smith, who was appointed Sept 1, 1867. Since that time he has been continuously at his post of business, not losing a single day.

A Four Years' Course in Electrical Engineering at Columbia College.

An undergraduate course of four years in electrical engineering has been established in the School of Mines, Columbia College, in addition to the present two-year post-graduate course which has been in successful operation for several years. Thus there will be two complete courses in electrical engineering in New York City.

The latter course is for graduates of scientific schools and colleges and is entirely devoted to electrical engineering proper, the students having already passed the necessary preparatory studies in mathematics, physics, chemistry, mechanics, drawing, etc. This course is found to give the most excellent results by reason of the maturer years and better training of post-graduate students.

In addition to such graduate students there are, of course, a much greater number of younger men who desire to enter a course of electrical engineering immediately on leaving school without going through a previous collegiate course.

A new four-year course has therefore been established parallel to the well known courses in mining engineering civil engineering, chemistry, architecture, etc., at the School of Mines, with the same requirements for admission which are the regular entrance examinations at first class scientific schools.

The first two years of the new course will cover the preparatory work in mathematics, physics, chemistry, mechanics, drawing, etc., required for admission to the post-graduate course. The last two years will be devoted to a thorough course in electrical engineering proper, and will be equivalent to the present post-graduate course, hence there will be no lowering of standard. As a preparation for the study of electrical engineering, the first two years of this course are equivalent to four years in any course other than electrical engineering, thereby saving much time without sacrificing any electrical engineering subjects.

The instruction in electrical engineering will be conducted as heretofore by Prof. Crocker and Dr. Pupin. The mathematics, physics, etc., will be taught by the respective professors of those subjects.

The Supply of Gutta-Percha.*

The increasing scarcity and cost of gutta-percha of good quality, due to the large demand of the present day, is a fact of so much importance that any prospect of increasing the supply must be hailed with satisfaction by all users of the gum; and it is therefore interesting to know that, according to M. Sérullas, the *Icosandra gutta* still exists in the island of Singapore, where for over thirty years it has been supposed to be extinct.

This re-discovery of the gutta-percha tree at Singapore is, however, hardly likely to benefit the users of the gum unless some less wasteful method of collecting it can be introduced, as the destruction of the trees by the native collectors goes on at such a rate that the Malay forests, from which our supply is now obtained, are each year growing smaller and smaller, and will, it is feared, be entirely destroyed in the course of a few years. As regards the method of collecting the gum, some interesting information is given in the current number of the Kew *Bulletin*, in which is published some correspondence giving an account of a process recently invented by M. Sérullas for extracting the gum from the twigs and leaves of the gutta-percha tree, and also of the earlier attempts made at the suggestion of Mr. Leonard Wray to extract the gum from the bark of the tree.

In a report made in 1883, Mr. Wray, after describing the method of collecting employed by the natives, says that the amount of the gum obtained from a single tree appears to have been greatly over estimated, and as bearing out this statement he quotes the yield, which was only two pounds five ounces, obtained from a tree two feet in diameter (measured six feet above the ground), about 100 feet high, and judging from the annular rings over 100 years old. When we consider that the annual export from the Straits Settlements is said to be about ten million pounds, the only wonder is that there is still such a thing left as the gutta-percha tree. Owing to the smallness of the yield obtained by him, Mr. Wray was led to make some experiments to determine what proportion of the total amount of gutta contained in a tree was obtained by the usual native methods, and how much was left in the bark; and for this purpose he had a tree felled, and scores cut in the bark at distances of 15 inches along the whole length of the trunk, from which he collected the gutta. He then removed some of the bark, pounded up a weighed sample in a mortar, and boiled it in water, when the gutta formed itself into small white flakes, which were collected into a mass by stirring, and purified by boiling in clean water. When weighed it was found that the yield of clean gutta-percha was equal to 5.3 per cent. of the weight of the sample of bark, or if

* From the *Electrical Review* (London).

INTERIOR VIEW OF THE SIGNAL ROOM OF THE BUFFALO FIRE DEPARTMENT.

he bark was first dried, which reduced its weight by about 50 per cent., the yield of gutta was over 10 per cent. By calculating the weight of bark on the trunk of the tree. Mr. Wray estimated the total weight of the gum contained in it, and found that, in this instance, it was 37 times the weight of the gutta obtained by the usual method of collecting.

Seeing the immense saving of trees which would result if the gum could be successfully extracted from the bark, Mr. Wray sent over a quantity of dried bark to Kew, with a request that a report might be obtained as to the yield of gutta, and its commercial value when obtained in this manner. This bark was sent to the Silvertown Company, who reported that they had obtained 13.6 per cent. of gutta and resin from it, but that the large amount of resin present made the product commercially valueless.

The process proposed by M. Sérullas does not necessitate the felling of the tree, but merely a pruning off of the twigs and leaves, and therefore it will, if successful, stop the wholesale destruction of the forests. The treatment is described as follows: The twigs and leaves are finely chopped up, and are then treated with acid (which is the main secret of the invention) until a reddish brown liquor is produced. This is put into an alembic, already supplied with a small quantity of water, to prevent the gutta from sticking to the sides of the vessel, and steam is applied for about 20 minutes or half an hour, during which the acid evaporates and is drawn off. It is stated that about two per cent. at least of pure gutta should be obtained from the raw material, and that a syndicate has been formed at Singapore to work out the process, and to establish a factory.

It is possible that, by acting upon fresh material, instead of dried bark, the gutta may be obtained in good condition; but even if more successful than the plan proposed by Mr. Wray, there still remains the difficulty of transport through the forest, and in this matter the increased weight of the raw material will tell very heavily against the process, unless plantations can be obtained in convenient positions to which access can be given by good roads.

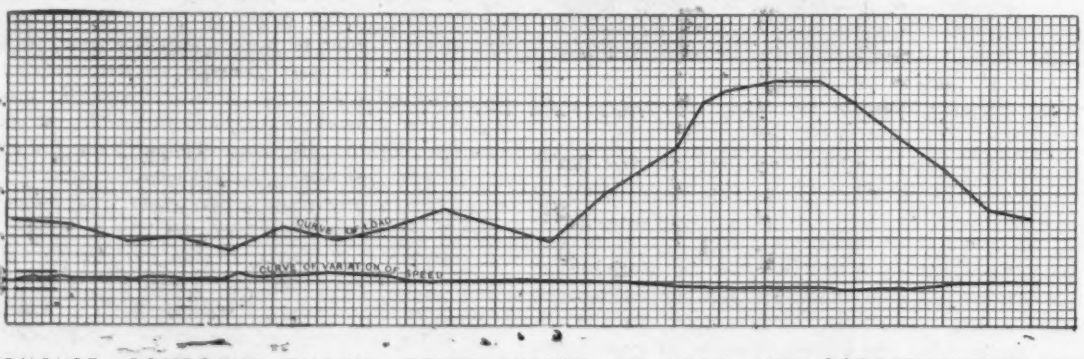
Close Speed Governing in Electric Railway Service.

Probably the severest duty imposed upon an engine governor is found in electric railway work, where the changes of load are practically instantaneous and often through a wide range, while the character of the service demands a constant speed. It is customary and considered sufficient in such work to measure the speed over a considerable interval of time, and the rate of speed per minute represented as the actual number of revolutions in that time; yet extreme fluctuations of load might change the speed (even if but momentarily) far above or below this reading without in the least affecting the average.

With a view to thoroughly investigate the efficiency of the Westinghouse compound engine governor in this respect, a test was made upon an 18 and 30 × 16 engine of this type at the power house of the Federal Street and Pleasant Valley Electric Street Railway by C. F. Scott, of the Pittsburgh Laboratory of the Westinghouse Electric and Manufacturing Company. A special instrument was designed by Mr. Scott, reading to one-hundredth of one per cent. variation of speed and registering every half second.

A milled centre inserted in that of the engine's shaft revolves a large wooden drum (whose circumference is 25 inches) at the same speed as the engine (250 revolutions per minute), while a belted screw feed moves an electromagnet, whose armature supports a pencil, longitudinally along the cylinder. Another part of the apparatus is a pendulum adjusted to beat nearly at the speed of the engine and make electric contact at the centre of its motion to operate the armature and pencil upon the drum. A strip of paper stretched upon the drum receives the impressions of the pencil, and when developed displays a line of elongated dots at an angle to the edge of the paper, whose inclination varies with the speed. The measured distance in inches of two dots that represent four revolutions of the engine or 100 inches of the drum is the per cent. of variation of the engine's speed from that of the pendulum; and a plotted series of these measured distances from a base line, shown in Fig. 1, with a connecting line drawn through them, is the record of the governor's performance. A horizontal distance of one small square corresponds to two revolutions of the engine, or an interval of one-half second of time; while a similar vertical distance represents a change of speed of one per cent. The curve above this illustrates the change of load by ampère readings over the same period of time.

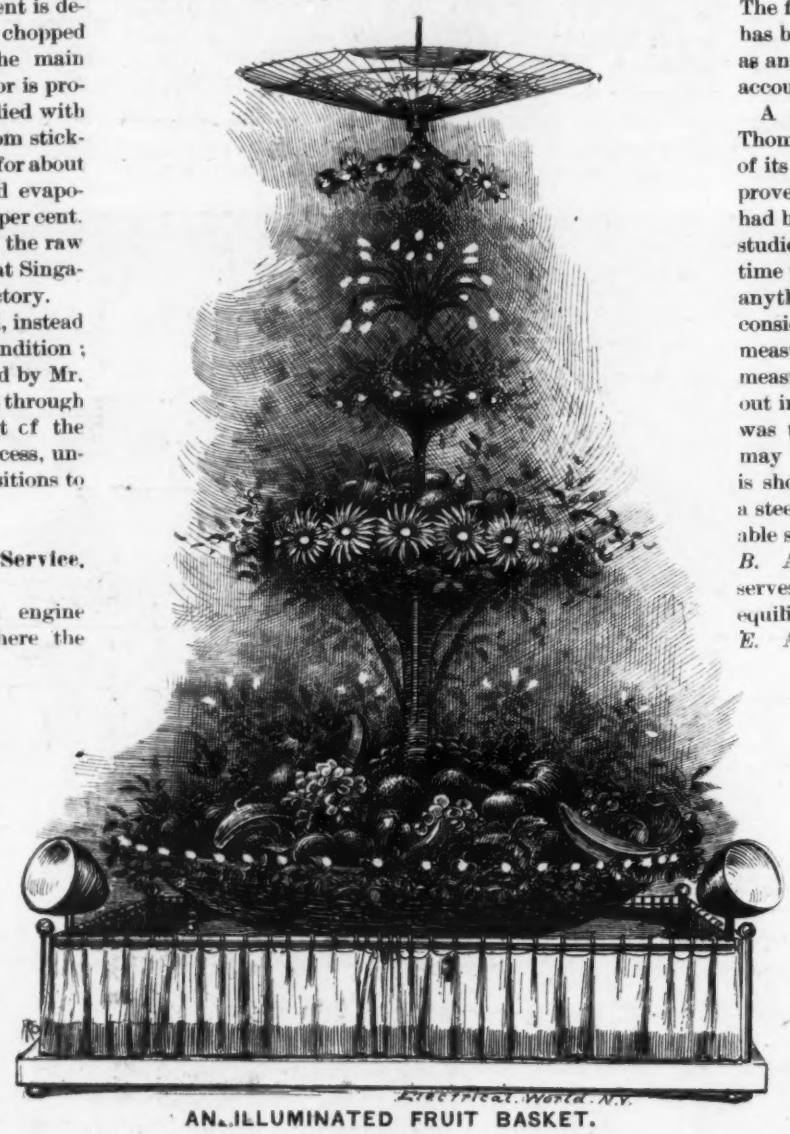
It will be seen that the engine changes but one per cent. each side of the neutral line representing the time vibration of the pendulum through a total change of current equivalent to two-thirds of the rated power of the engine.



WESTINGHOUSE COMPOUND ENGINE TESTS—CURVES OF LOAD AND CORRESPONDING CURVE OF VARIATION OF SPEED.

Illuminated Fruit Basket.

A very pretty lighting effect was recently obtained in the pyramid of fruit exhibited at the Lee Avenue Congregational Church fair, held in Brooklyn. This was designed and made by Mr. W. T. Knox, of McCormick, Hubbs & Co., wholesale fruit dealers, 250 Washington street, New York City.



AN ILLUMINATED FRUIT BASKET.

The structure, as will be seen from illustration, was made up of three sections, and was mounted upon a dial operated by a small electric motor. Ten cells of Mason primary batteries were used, there being five series of two each. The lower basket had 15 miniature lights of two candle power each. These were divided into sections of three each. There were also three sets of colored lights distributed among the fruit.

The outer edge of the second basket was lighted with miniature lamps set in artificial flowers, while the third elevation had a set of nine lights. From the top of the structure a cluster of eight colored lamps sprang in every direction.

At the base four small incandescent reflectors were arranged, these remaining stationary, while the structure itself was rotating. There were in all 86 small lamps and 30 varieties of fruit in the basket.

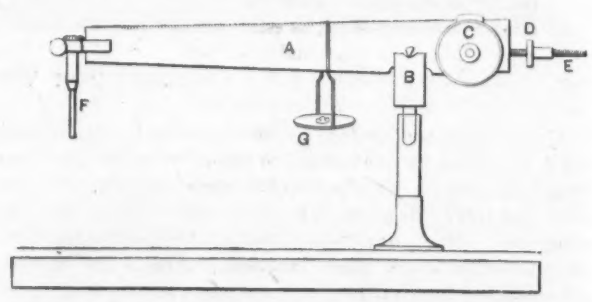
By an ingeniously devised commutating switch, Mr. Knox was able to get numberless combinations of light and the entire effect was very beautiful. A similar design filled with flowers would be a beautiful piece for a banquet table. He intends to construct apparatus of this kind for permanent displays, and should meet with success.

He is an enthusiast in electrical matters and has from time to time designed many ingenious electrical devices. The basket illustrated was completed, so far as the mechanical and electrical parts are concerned, by constant evening work in October last.

The Relative Hardness of Various Kinds of Electro-Plating.*

Few exact experiments have been recorded dealing with the subject. The reason for this apparent neglect of what is a matter of some scientific interest, as well as of much technical importance, is to be found in the fact that the accurate determination of the hardness of metals and alloys has only been possible comparatively recently. The fundamental error made by all the earlier devisers of apparatus for the determination of hardness has been that they have overlooked the fact that the hardness of a material is distinct from its tenacity, and methods of measuring the one must be so planned as to be uninfluenced by the other. The failure to appreciate and comply with this condition has been the cause of much wasted ingenuity and effort, as any one will admit who cares to refer to the published accounts of former investigations made in this direction.

A few years ago an instrument was designed by Mr. Thomas Turner, of Birmingham, which avoided the errors of its forerunners almost completely. Like all notable improvements, it owed its excellence to the fact that regard had been paid by its inventor to first principles. Having studied the various methods that had been from time to time proposed, and in some cases actually used in default of anything better, he perceived their inherent defects, and considering precisely what it was that was required to be measured, he abandoned the lines upon which the largest measure of success had been previously attained, and struck out in an entirely new direction. The instrument, which was the outcome of his researches, is simple enough, as may be seen from the illustration, in which one form of it is shown. A graduated beam, *A*, with unequal arms like a steelyard, rests upon knife-edges, which bear upon suitable steel or agate surfaces carried on the head of the pillar *B*. A counterweight, *C*, on the short side of the beam serves to balance the longer arm, and final adjustment of equilibrium is made by the nut *D* moving along the screw *E*. At the end of the longer arm of the beam is a brass style, *F*, shod with a small diamond. A scale pan, *G*, moves along the longer arm of the beam, and by its position and the weights it contains determines the pressure which the diamond point exercises upon any surface placed beneath it. The pillar *B* has the upper part bearing the beam pivoted vertically to the lower, so that the beam can be swung bodily round in a horizontal plane, thus moving the diamond point in an arc of any desired length. It will be at once apparent that, when a highly polished surface is placed beneath the diamond point and a load of suitable magnitude caused to rest upon it by sliding the scalepan along the beam, on drawing the point across the surface by swinging the beam upon its pivot an abrasion will be made on the surface if the pressure be sufficient. The load that is necessary to produce this effect is a measure of the hardness of the material under examination. When this instrument is first used by one unfamiliar with the indications it gives, a difficulty is experienced in discriminating between the line made by a pressure on the diamond point, which is insufficient to cut through the surface of the test-piece, and a true abrasion. Even with a very light load, particularly in the case of somewhat soft materials, a sort of smoothing of the portion of the surface which has been traversed by the diamond point will be perceptible, and is easily mistaken by the inexpert for a true scrach. When once the use of the sclerometer—for that is the name of the instrument—has been learnt, no difficulty is found in distinguishing between these two appearances, and the determination of the hardness of any given substance becomes comparatively easy.



INSTRUMENT FOR TESTING THE HARDNESS OF ELECTROPLATING.

Considering its merits it is a little surprising that the sclerometer has not been more widely used for purposes of technical research. A question such as the relative hardness of the film of metal deposited by electrolysis as a protection to the base body of the article coated, which is acknowledged to be of considerable importance, and has hitherto been subjected to no more fruitful form of investigation than that of vague qualitative discussion, can be

* From the *Electrician* (London).

settled with ease and accuracy by its means. An instance of what can be done in this direction is afforded by a determination that was recently made of the hardness of three well-known plating materials, silver, nickel, and the zinc-silver alloy now being introduced by the London Metallurgical Company. The tests were carried out by Messrs. Stanger and Blount, of Broadway, Westminster, who adopted the use of the sclerometer in their practice as engineering chemists shortly after its appearance.

The results of their investigations are shown in the following table:

Sample.	Condition of Sample.	Hardness.
Nickel anode	Rolled	11.5
Nickel anode	Rolled, annealed	8.6
Arcas anode	Cast	5.5
Silver anode	Rolled	4.5
Silver anode	Rolled, annealed	3.5

The numbers represent the weight in grammes to which the pressure of the diamond point upon the test piece is equivalent. An idea of their value may be obtained from the numbers corresponding to the hardness of a few common metals. Thus, ordinary commercial lead requires a pressure of one gramme on the diamond point to be definitely scratched; tin has a hardness of 2.5; copper about 8; mild steel averages 21; while harder steels and hard cast irons have a hardness of 25.30 or more, and ordinary window glass gives a result of about 60.

The figures are interesting as establishing the claim made for "Arcas" that it is appreciably harder than silver. Of course, both are considerably softer than nickel, the hardness of which is well known, and for many purposes objectionable. The value of the testimony in favor of the new method of plating would be much enhanced by the publication of the results of experiments made on the metals in their deposited form, as it is quite conceivable that an alteration in their molecular condition might occur in the act of deposition, and their hardness, among other properties, might suffer change.

Four Electrical Libraries Secured.

In September THE ELECTRICAL WORLD offered electrical books to the value of $50, $30 and $20 respectively for the three largest lists of subscribers received before Nov. 30.

In case that more than 33, 20 or 13 yearly subscribers were obtained, additional books were to be sent to the value of $1.50 for each extra subscription.

Forty-three yearly subscriptions were received before Nov. 30 from a gentleman who, for personal reasons, prefers that his name should not be published, and books to the value of $64.50 have been sent to him.

Mr. E. A. Darling, of Hopedale, Mass., was the sender of the next largest list, comprising twenty-one yearly subscribers, and to him have been shipped books to the value of $31.50.

Mr. E. A. Bostrom, of Atlanta, Ga., and Mr. W. P. Hazen, of Marion, O., each sent in eleven subscribers. Although only one third prize had been offered, books to the value of $20 have been sent both to Mr. Hazen and to Mr. Bostrom.

THE ELECTRICAL WORLD now renews the offer and shortens the time. Books to the same value and on the same terms will be forwarded to those sending the three largest lists of yearly subscribers at $3 prior to Jan. 31, 1892. As the time is so short, those wishing to enter the list ought to do so at once.

Speed of Electric Cars in City Streets.

BY CHAS. HEWITT.

It has been asserted that it is impossible for any car operated on the surface of a city street to make real rapid transit, on account of the crowded condition of the streets. A close study of our large cities will show that the principal lines of travel are crowded for only short distances, and that beyond these crowded portions a high rate of speed can be maintained with safety. In New York, for instance, Broadway is very crowded from Bowling Green to Canal street, moderately crowded from Canal to Fourteenth. Above Fourteenth street a car is seldom impeded. Fulton street, Brooklyn, is crowded from the East River Bridge terminus to De Kalb avenue, beyond which point the cars branch off and run for long distances with almost no interruption except that due to passengers getting on and off. In Boston, Tremont street is the most crowded; in Minneapolis, a short portion of Washington street, and in Milwaukee, East and West Water streets, between State and Clybourne. The same will be found true for any large city. It only remains to be shown, then, what the electric cars can do with safety on the unobstructed portions of their routes.

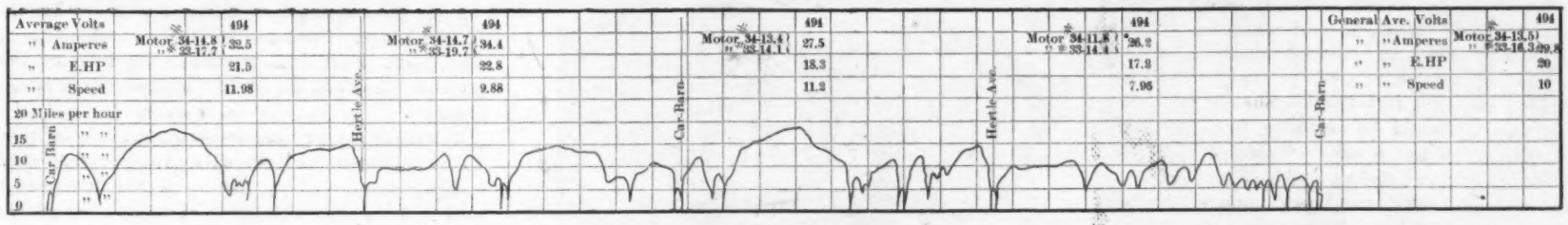
Much has been said and written about the speeds of electric cars, but so far as the writer is aware no speed record of an electric car in actual service has ever been published heretofore. Last summer the writer had the pleasure of making some tests for the Edison General Electric Company, on Niagara street, Buffalo, covering this question, and the result of those tests is shown in the accompanying diagrams. The route extends from Main street, in the heart of the city, to Hertle avenue, by way of Niagara street, a distance of 4½ miles, or nine miles for the round trip. The schedule time, including terminal stops, is 64 minutes, or an average running speed of nine miles per hour. Referring to the diagrams we will see what speeds the car actually made in order to fill the schedule requirement. A few words of explanation will perhaps make the diagrams clearer. The record was made by a Boyer railway speed recorder,* belted direct to one axle by means of a flexible wire belt. Every movement of the car either forward or backward is therefore recorded. The horizontal lines represent speed in miles per hour as shown at the left hand end of each diagram. The vertical lines represent quarter mile distances.

The car in each instance was started from the car barn, which is in the middle of the line, and run to Hertle avenue, the suburban terminus, thence back to Main street, the city terminus. Ampère and voltmeter readings were taken every 15 seconds, and when the car was carrying passengers the number on the car was noted every time any one got on or off. The car was 35 feet long over all, was mounted upon two trucks, and weighed with the No. 10 and No. 14 motors about 20,000 pounds and with No. 12 motors about 22,000 pounds.

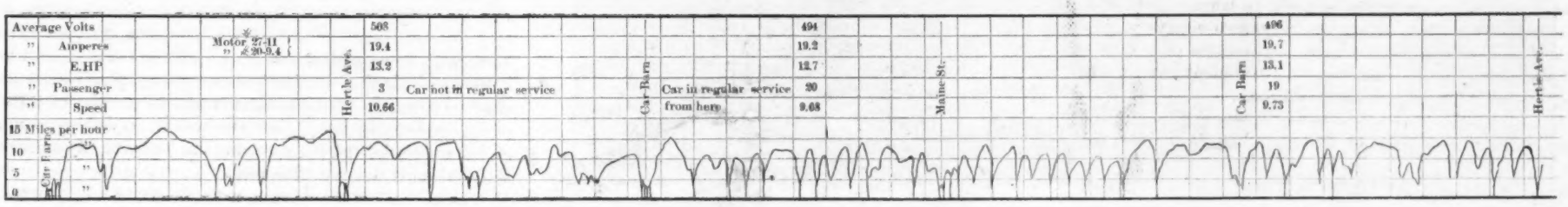
The first test was made with the No. 10 motors; the car being run from the car barn to Hertle avenue terminus and back to car barn without passengers in order to determine what was the highest speed that could be obtained. As the car had to be run in between two cars in regular service the result is somewhat less than what it would have been if the track had been entirely unobstructed, but it will be noted that a speed of 21 miles per hour was attained within a distance of 2,100 feet from the full stop. The gradual acceleration of speed shown by the gentle curvature of the line is also of some interest. The remaining runs before reaching the car barn were interfered with by overtaking the car ahead, although a speed of 17¼ miles was attained At the car barn the car was put in regular service carrying passengers, and the record speaks for itself. The average speed shown is somewhat greater than the schedule speed, as the time of stops is not recorded. It is interesting to note that in order to make a schedule speed of nine miles per hour it is necessary to make a maximum speed of about 13½ miles, or 50 per cent. above the schedule speed. This record also shows that a car can attain a speed of 15 miles per hour within a distance of 350 feet from full stop.

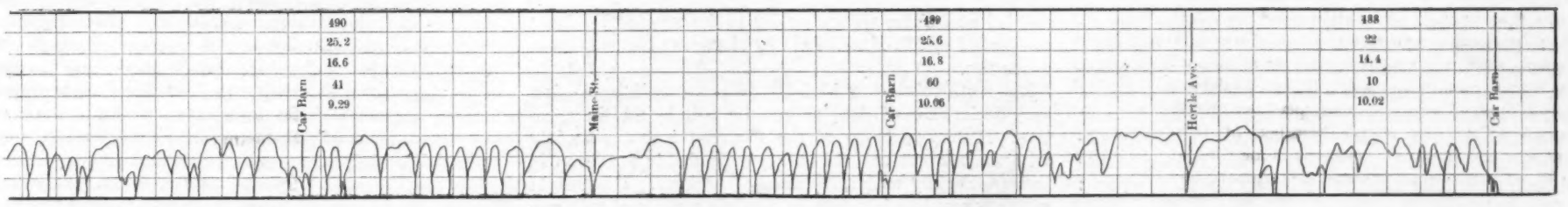
The next test was made with the No. 14 motors. These motors were mounted on the same trucks that had been used in the previous test with the No. 10 motors. The car was first run to Hertle avenue and back without passengers, and was then put in reglar service. In connection with this diagram I wish to refer to what has been said in the beginning of this article. Although no part of Niagara street is very crowded, still the interference is greatest near the Main street terminus. It will be noted that in every instance between Main street and the car barn the stops are very numerous, for long stretches being one to every block (about 600 feet). Between the car barn and Hertle avenue, however, the stops are comparatively few, and it is here we would expect to get a greater speed, as is distinctly shown by the diagram. It is not so prominent, however, as it would have been had the required schedule speed been 10 or 12 miles per hour, as on some of the long lines in Boston and other cities. It is evident from the first part of this diagram that a speed of 17¼ miles could have been maintained for long stretches if necessary, thereby increasing the average speed.

The third test was made with the No. 12 motors. These motors are larger and more powerful than the No. 10 and No. 14. The same car body was used as in the former



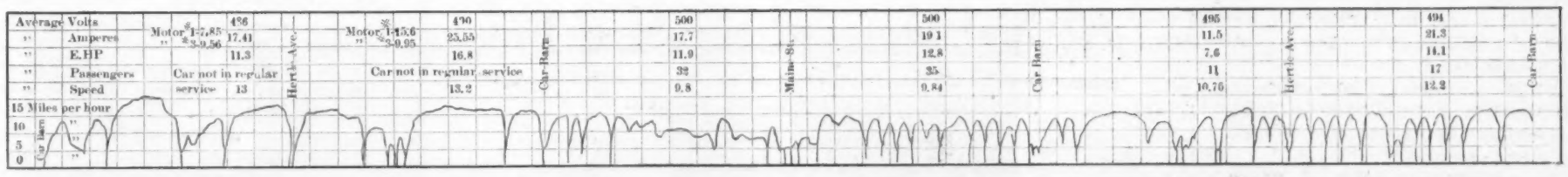
TEST OF CAR NO. 3, EQUIPPED WITH TWO NO. 12 MOTORS. LOAD ABOUT 22,000 POUNDS. TRACK NEARLY LEVEL.





TEST OF CAR NO. 3 EQUIPPED WITH TWO NO. 14 MOTORS. AVERAGE LOAD ABOUT 27,000 POUNDS. TRACK NEARLY LEVEL.

Average of Total Readings: 494 volts, 22.4 ampères, 14.9 e. h. p., and 35 passengers. Average speed without passengers, 10.63; with passengers, 9.73 miles per hour.



TEST OF CAR NO. 3 EQUIPPED WITH TWO NO. 10 MOTORS. AVERAGE LOAD ABOUT 27,000 POUNDS. TRACK NEARLY LEVEL.

Average of Total Readings: 494 volts, 18.8 ampères, 12.4 e. h. p., 24 passengers. Average speed without passengers, 13.1, with passengers, 10.4 miles per hour.

*For a description of this instrument see THE ELECTRICAL WORLD, April 18, 1891.

tests, but the motors were mounted on new trucks, used for the first time in this test. For this reason the car was not put in regular service. Two trips were made from the car barn to the Hertle avenue terminus without passengers with results as shown in the diagram. Since this test was made this car has attained a speed of 28 miles per hour and has shown an average ampère consumption of less than 20. With regard to the average ampère readings in all these diagrams it may be said that they are somewhat higher than they would be in ordinary practice, due to the long runs at high speed without passengers and also to the fact that the starting current is included in many readings.

Safety Devices Used in Electrical Work.*

BY CHAS. WIRT.

The title of the paper which we have listened to is a very broad one—a great deal too broad to follow out in detail within a limited time. I shall, therefore, confine my remarks to the matter of "fusible cut-outs," having had more experience with that branch of the subject than with some others. Nobody will disagree with me when I say that a perfect material for fusible strips has not yet found its way into the market. The choice of materials ordinarily obtainable is quite limited. The characteristics of a good material for fusible strips can be very briefly stated. They are:

1. Low resistance.
2. A low fusing point.
3. Permanency under normal conditions.
4. Tenacity.
5. If used as very many of the fuses are used to-day, the quality of making and keeping a good contact under a screw head or clamp.
6. A high temperature coefficient of resistance.

The first characteristic—"low resistance"—is often overlooked, although it is a very important one. A fuse when called upon to act cannot act too quickly. The promptness with which it will act depends upon the energy expended, its mass, specific heat, surface and rate of radiation. This appears rather complex, but it practically means that a low resistance material will be of small cross section, and consequently light weight and small surface, the result being that with a given energy expended upon it it will be raised to a given melting point much more quickly than a fuse of corresponding ampère capacity made of a high resistance material which will call for an increased cross section, weight and surface. No mention is here made of the fact that the fuse of lower specific resistance will have a lower actual resistance and save a very small amount of energy continually wasted; energy, which, though small in the individual, is worth considering in the aggregate of a large insulation.

The second characteristic—"low fusing point"—is less important than commonly believed. It is usually quoted on account of the fact that wooden fuse blocks are possibly still used to a small extent, but the difficulty of setting fire to a wooden block by means of a fuse wire with any fusing point lower than that of silver can hardly be appreciated until one has tried it. Low specific resistance and low fusing point in the same material, comparatively speaking, cannot be had. Pure tin probably comes the nearest to possessing both characteristics of any material commercially obtainable. Tin, however, has bad qualities of its own which fully offset its good qualities. It is very well known that a fuse of pure tin when heated to near the melting point forms a tough skin of oxide, which acts as a sac to hold the melted metal and will sometimes prevent the rupture of the fuse indefinitely. Other materials show the same tendency to a less extent. Further than this, for low specific resistance a pure metal would be chosen which will also give us the fifth desideratum—a high temperature coefficient. For a low fusing point, on the other hand, an alloy would certainly be chosen. Regarding the third point—"permanence"—little need be said, as the ordinary material for fuses suffer little with time except when exposed to chemical action in contact with other metals.

The fourth point—"tenacity"—is important, as fuses are subjected to rough handling before being put up and are liable to be strained when screwed or otherwise fastened into place.

The fifth point—"good contact"—is the sore point of most fusible cut-outs. We all know that these should be provided invariably with copper terminals for perfect contact under the screw head. We also know equally well that often this is not done. Lead, tin, or lead-tin alloy, if bright at the start and fairly secured under the head of a binding screw, will do very well for a while, but differential expansion, corrosion, vibration, and in the case of alternating currents some subtle effects, due possibly to the alternation, will get in their work, and after a time the fuse blows from poor contact. In many cases the final result is just such an approximation to the copper "bus bar" mentioned by Mr. Haskins as the circumstances may seem to require.

The sixth point—"a high temperature coefficient"—is a very desirable condition, as can be seen by a little reflection. If the resistance of the material increases rapidly with the temperature, the energy expended in the fuse will increase rapidly with an increase of current. The margin which is required in a fuse is really a margin of temperature. We do not wish to work our fuse above the temperature at which it will be both safe and stable. If we require a margin of say 100 or 200 degrees between the normal current and the fusing current we can get this with a large current variation in the case of an alloy having a small temperature coefficient, and with a small current variation in a pure metal having a large temperature coefficient. Out of a large amount of experimental work which I have done on fuses, about the only piece which seemed entirely successful and satisfactory was a fuse designed to be made of two iron wires tinned together the whole length and each wire cut, with a certain linear distance between the cuts, thus leaving a section between the cuts joined by the tin only. This fuse was designed to protect the lamps in a series circuit in case of a cross in the line, which accident generally resulted in the burning out of all the lamps inside the cross. By the use of this fuse, having pure iron wires drawn to an even gauge and tinned uniformly with pure tin, it was found possible to cut down the margin to 10 per cent. or less, the fuse acting so quickly as to save the lamps in circuit in case of any sudden cutting out of a portion of the circuit. This arrangement could not be considered practical for ordinary low tension work, which is the condition for which fuses are used mostly. I am glad Mr. Haskins mentioned the matter of extremely fine fuses, as that is a question I happen to have in hand at the present time. That these are urgently demanded is amply attested by the amount of effort recently spent on such fuses. The extremely rapid dissipation of energy from wires of small diameter pointed out first, I think by Mr. Preece, is a great difficulty in securing accurate fuses of small capacity.

* A discussion of Mr. C. C. Haskins' paper on this subject read before the Chicago Electric Club, Dec. 7, 1891.

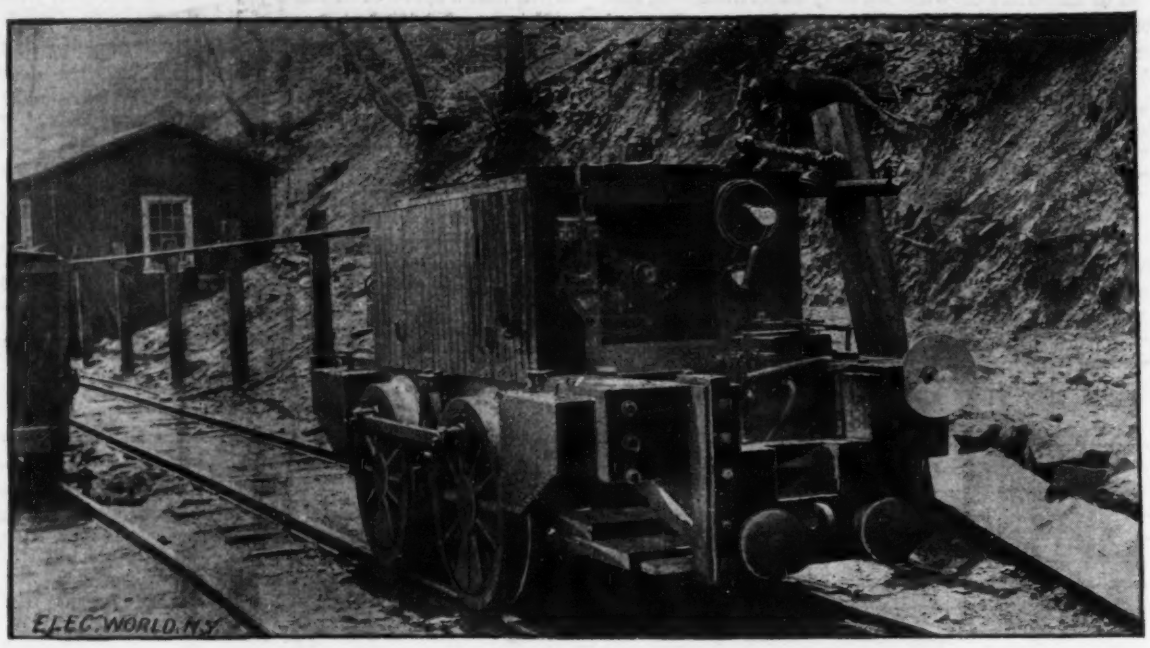


FIG. 1.—FIRST SCHLESINGER MINING LOCOMOTIVE.

Electricity in Mining.—IV.

MINE HAULAGE.

We now come to one of the most important of all features of mining—transportation. Whatever the character of the material mined and the method of mining it, it must be brought to the surface, and then hauled greater or less distances.

From the earliest times animal power has been employed for this work. Even to-day, though various improved systems have come into the field, the time-honored use of mules is observed in some localities with religious persistency.

The ideal mechanical locomotive would, of course, embrace all the advantages of animal power—be absolutely self-contained, independent of all outside agencies, and introduce no element of danger. The steam locomotive, though possessing certain advantages, is open to the very serious objections of introducing the danger of fire always attendant upon its use underground; the necessity of a large supply of air for its maintenance, and the vitiation of the atmosphere, which precludes its use except in passages traversed by the return ventilating air currents. Aside from the production of noxious gases, the heat, smoke and steam, likely to cause chemical decomposition of the mineral constituents of the roof, render frequent renewals of the timbers necessary.

While the rope haulage system enjoys many valuable features, it has many inherent defects. Among these may be mentioned excessive wear of the rope, with consequent high cost of maintenance; low efficiency, where the transmission is of considerable length, and the liability of the whole system being disabled from the breaking of the cable or the stoppage of the driving engine. The necessarily permanent character of the installation prevents the use of this system for collecting cars, and for the operation of side and new workings of a temporary nature.

The manifest advantages of the electrical method of haulage are almost too well known to need rehearsal here, and no better comment on its value can be made than to call attention to the great number of street railways and surface tramways now being operated by electricity. At the present time more than 400 street railways are thus operated, while the number of tramways is very large. Aside from the elements of economy and convenience which have secured for it such a wide application, the electric motor underground is especially valuable, since it brings into the mine no element of danger.

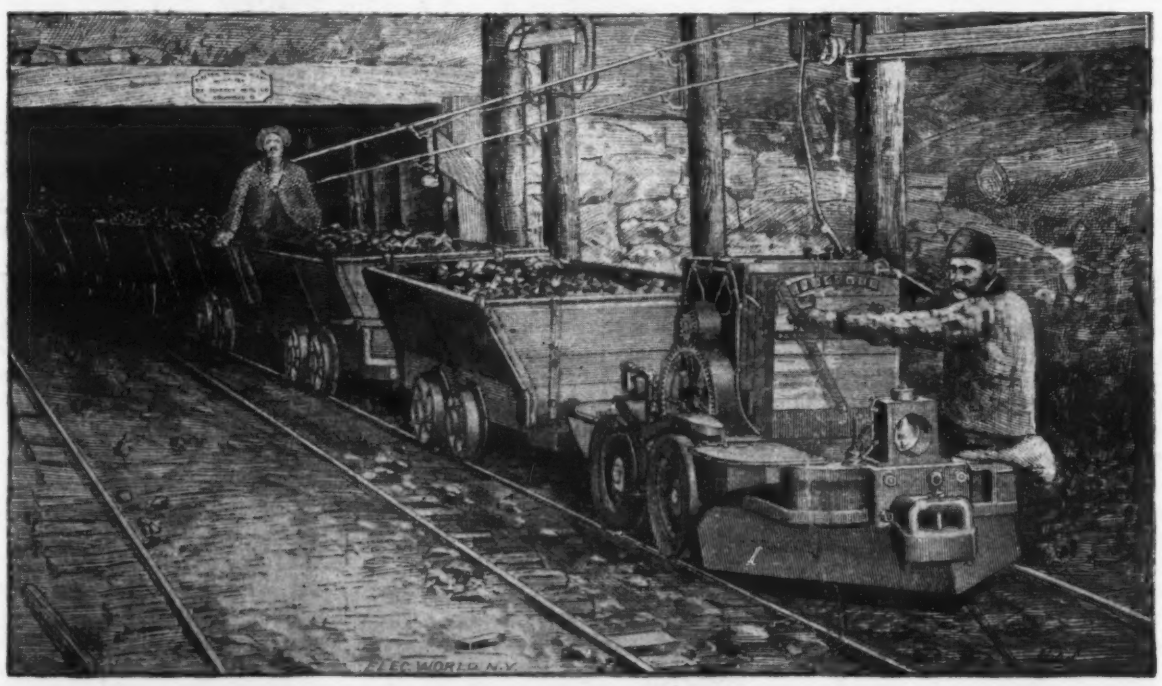


FIG. 2.—JEFFREY MINING LOCOMOTIVE.

The first electric mine locomotive to be operated in this country was installed by Wm. M. Schlesinger in the mine of the Pennsylvania Railroad Company, at Lykens, Pa., in July, 1887, a view of which is given in Fig. 1. The plant consists of two generators, one locomotive and the Bernstein system of electric lights. The power house is located at the entrance of drift No. 1, into which the locomotive runs. The length of the road is 6,300 feet, and contains two sharp curves within 180 feet of each other. The maximum grade

against the load is one and a half per cent. The heaviest load hauled by the locomotive over this road consists of 31 cars, weighing on an average five tons, and trains of this this weight are constantly being hauled without any difficulty.

The second haulage plant to be put in operation was the one running at Iron Point, Shawnee. The first locomotive used was one built on the spot, and afterward repaired and somewhat altered in the machine shop at Newark. This locomotive has since been replaced by one of the Jeffrey make, which continued to do satisfactory work until the mine was closed because of legal difficulties in 1890.

Fig. 2 shows a Jeffrey locomotive hauling a train of loaded cars, this view being made from a photograph. This locomotive consists of a cast iron frame composed of two C-shaped castings bolted together. The motor is mounted on this frame with its armature parallel to the axles of the car. Spur gears transmit the power direct to both axles, and a wire resistance is used for regulation.

This locomotive has been worked on a grade against loads up to 4½ per cent. Its greatest length is 8 feet 6 inches by 46 inches at the highest point. The trolley used is one that has found much favor in mining work, being what is known as the "double trolley" pattern. In many instances it is impracticable to use the single trolley, for the reason that drippings and water make the rail return a very undesirable conductor. The Jeffrey trolley has four wheels, and is connected to the motor by means of a flexible cable, the wheels running in grooves formed by two channel irons fastened about eight inches apart.

When this road was in operation the locomotive hauled a maximum of 30 tons up a grade of four per cent. at a speed varying from 10 to 12 miles an hour. The power house was located 600 feet from the terminus of the road.

Jeffrey machines are at present in use in different parts of the country, doing various kinds of mine haulage, and their operation demonstrates the value of this new application of electric current.

Another early haulage plant was that installed by the Thomson-Van Depoele Electric Mining Company at Erie Shaft, Hillside, Pa. This was started in October, 1889, and was the first locomotive designed by Van Depoele, having since been superseded by the well-known "Terrapin Back" type shown in Fig. 3. This first locomotive was in successful operation until the adoption of a new type, hauling trains weighing 60 tons. A peculiar feature of the installation was the large number of switches occurring on the road, one branch alone being 1,500 feet long.

The advantage of using lights at all places where permanent work is going on is well demonstrated in this mine. At the foot of the shaft and at all switches and turn-outs incandescent lights are constantly burning. Those at the foot of the shaft are of special importance, as the light at that place enables quick work and reduces the liability of accident.

The "Terrapin Back" locomotive of the Thomson-Van Depoele Company has many features of especial value. It is solidly built and very compact. The interior mechanism is well protected by a heavy iron armor. The motor is of the ironclad consequent-pole type, having a Gramme ring armature. It is situated midway between the axles, the proper speed reduction being attained by a train of gears. The locomotive can be run at various speeds, the motors being wound for any speed from four to ten miles an hour. The motor has a capacity of 60 h. p. The total height is only 39 inches from the top of the rail. By the use of the "double elbow" trolley, the locomotive adapts itself to the varying heights of the trolley wire within any reasonable range. The sheet iron covering makes a complete water tight armor, protecting the moving parts from danger of falling rock or bodies of ore and coal.

Another interesting electric haulage plant has been in operation for a number of years at the Jobs Collieries, Hocking county, Ohio. It was installed by the Sprague Electric Railway and Motor Company, and has a line about 2,000 feet in length. A round trip over this road, including switching and coupling at both ends, is made in eight minutes, and recently, during a rush, 96 loaded cars were delivered in 96 minutes.

The Edison General Electric Company, which succeeded the Sprague Company, has adopted several types of mine locomotives, the most recent and important of which is shown in Fig. 4. This is a 110-ton locomotive, propelled by a 70-kilowatt motor. The motor is of the multipolar type, designed to run on 500 volts with 20 ampères, giving a speed on the level of 7½ miles an hour. At this speed it will pull a train weighing 110 tons.

The magnet frame is of cast iron, and has four inward poles upon which the magnet winding is placed. The power is transmitted from a pinion on the armature shaft to the wheels by a series of gun metal gears. The axles are connected by two parallel rods on either side of the locomotive. The motor is controlled by means of three switches—main, reversing and regulating. The main switch is used for starting and stopping; the reversing switch for changing the direction, and the regulating switch for increasing or diminishing speed. The driver has thus all the controlling levers within easy reach. Draw-head boxes are fixed at either end, so that the coupling link can be secured at any desired height. The total height of the locomotive is 49 inches, width 57 inches and length 128 inches.

A unique feature of electric mine haulage is that hoists operated on the same circuit with the locomotive may be employed to help out the latter when an incline occurs in the road, thus permitting the use of much smaller locomotives than would otherwise be possible. To illustrate: For certain haulage work in a coal mine, a 40 h. p. locomotive is necessary. As the entry is driven forward a fault is met with, and the grade for a comparatively short distance is so increased that the locomotive will be unable to handle

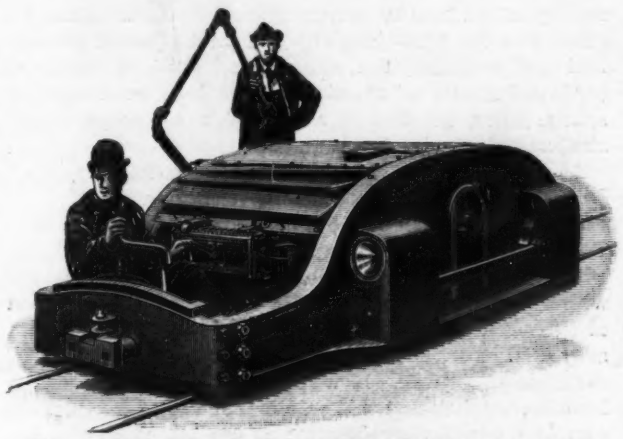


FIG. 3.—TERRAPIN BACK MINING LOCOMOTIVE OF THE THOMSON-VAN DEPOELE COMPANY.

the work. A small stationary hoist set up at the top of this hill will remedy the difficulty.

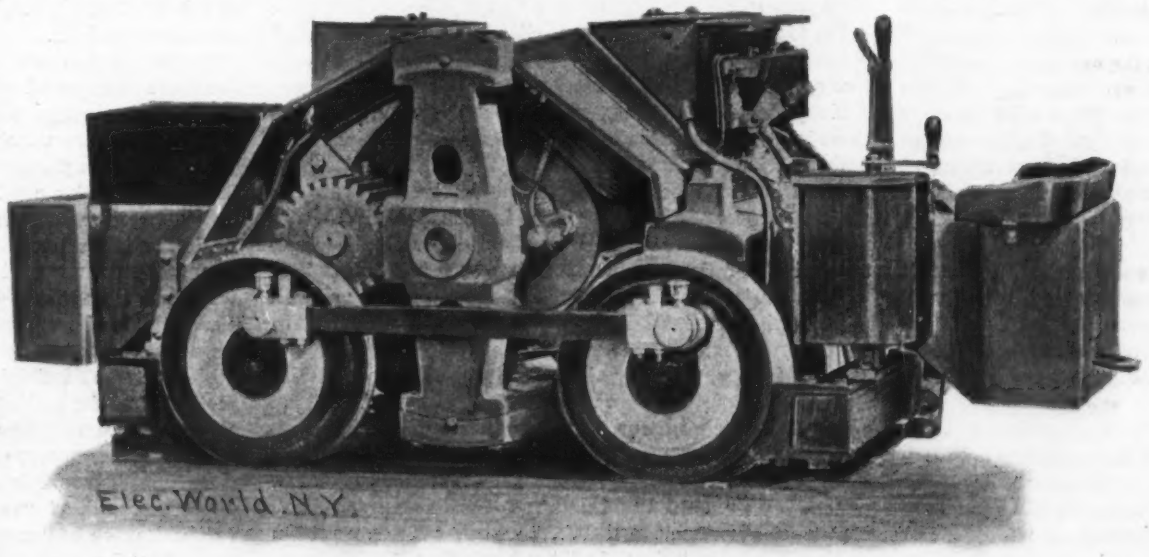


FIG. 4.—LATEST TYPE OF EDISON MINING LOCOMOTIVE.

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1785.——Marum (Martin Van), a Dutch electrician who had in 1776 taken the degree of M. D. at the Academy of Groeningue, constructs for the Teylerian Society at Haarlem, with the assistance of John Cuthbertson, an electrical machine said to be the most powerful theretofore made. According to Cavallo (*Nat. Phil.*, 1825, vol. II., p. 194) it consisted of two circular plates of French glass, each sixty-five inches in diameter, parallel with each other on a common axis, and about seven and a half inches asunder. Each plate was excited by four rubbers, the prime conductor being divided into two branches which entered between the plates and, by means of points, collected the electric fluid from their inner surfaces only.

In Van Marum's machine, the positive and negative electricity could only be obtained in succession, but Dr. Hare, of the University of Pennsylvania, remedied this by causing the plates to revolve horizontally. The machine was so powerful that bodies at a distance of forty feet were sensibly affected; a single spark from it melted a leaf of gold and fired various kinds of combustibles; a thread became attracted at the distance of thirty-eight feet, and a pointed wire was tipped with a star of light at a distance of twenty-eight feet from the conductor.

Descriptions of his machines are given by Dr. Van Marum in letters to the Chevalier M. Landriani and to Dr. Ingen-housz, both printed in Haarlem during 1789 and 1791. The first quarto volume of *Nicholson's Journal* also contains a reference thereto and contains (page 83) the extract from a letter read June 24, 1778 (*Phil. Trans.*, vol. LXIII., pages 333–339), addressed to Dr. Franklin, F. R. S., by Jonn Merwin Nooth, M. D., who describes improvements by which machines are rendered effective in all kinds of weather. Nooth was the inventor of the silk flap, of which mention was made in the description of Cavallo's machine (under A. D. 1775).

A powerful battery constructed by Van Marum, the metallic coatings of which were equal to 225 square feet, enabled him to give polarity to steel bars nine inches long, nearly half an inch wide and one-twelfth of an inch thick, to sever a piece of box wood four inches diameter and four inches long, to melt three hundred inches of iron wire one one hundred and fiftieth of an inch diameter, or ten inches of one one-fortieth of an inch diameter. It is said that, during such experiments, the report was so loud as to stun the ears, and the flash so bright as to dazzle the sight.

Dr. Van Marum also made experiments upon the electricity developed during the melting and cooling of resinous bodies, which are detailed in the article "Electricity," *Encyclopædia Britannica*, vol. VIII., p. 565, and likewise upon the effects of electricity on animals and vegetables, which are given at pages 49 to 51 of the article "Electricity" in the *Library of Useful Knowledge*, as well as in *Encyclopædia Britannica*, vol. VIII., pp. 602, 603.

It was also in 1785 Van Marum discovered that electric sparks, on passing through oxygen gas, gave rise to a peculiar sulphurous or electrical odor, which Cavallo called "electrified air," and the presence of which Dr. John Davy, brother of Sir Humphry Davy, found the means of detecting.

During the month of October, 1801, Volta wrote a letter to Van Marum asking him to make in concert with Prof. C. H. Pfaff, of Kiel, several experiments on the electricity of the pile, with the very powerful apparatus of the Teylerian Society. The extended researches of these two scientists are embodied in the *Phil. Mag.*, vol. XII., page 161, as well as in the "Lettre à Volta, etc.," published at Haarlem in 1802, and are likewise treated of in a very complete manner throughout chapters XVI. and XXXII. of Wilkinson's well known work on galvanism. Their observations confirm the doctrine of Volta as to the identity of the current of the fluid put in motion by the voltaic pile and of that to which an impulsion is given by an electrical machine, thus answering the question asked during May, 1801, by the Haarlem Society of Sciences, viz.: "Can the voltaic pile be explained in a satisfactory manner by the known laws and properties of electricity; or is it necessary to conclude the existence of a particular fluid, distinct from the one which is denominated electrical?" They also demonstrated that the current put in motion by the voltaic pile has an enormous celerity "which surpasses all that the imagination can conceive." With a pile of one hundred and ten pairs of very large copper and zinc plates, they made experiments on the fusion of iron wires and ascertained the causes of the more considerable effects of large piles in the fusion and oxidation of metals, proving, among other facts, as Biot and Cuvier had already done, that a part of the oxygen is absorbed whether the operation be carried on in the open air or *in vacuo*. (See Biot and Cuvier, *Soc. Philomathique*, An. IX., page 40; *Annales de Chimie*, vol. XXXIX., page 247.)

Another of Van Marum's experiments is related in a letter to Mr. Berthollet, wherein he says. " . . . I have succeeded in the decomposition of water, by means of the current of the electrical machine, provided with a plate of thirty-one inches diameter, constructed by me on a new plan (see the *Journal de Physique* for June, 1795). . . . I took a thermometrical tube, of the kind employed in making the most sensible thermometers of Crawford and Hunter, for which purpose I had procured several of these tubes some time before in London. Its diameter interiorly was not more than the hundredth part of an inch; and I introduced into it an iron wire of the diameter of about the three-hundredth part of an inch, to the depth of about twelve inches. I now closed the end of my thermometrical tube with sealing wax in such a way as that the extremity of the iron wire should scarcely project, and placed the tube itself, by means of a cork, within a larger tube containing water. The rest of the apparatus was arranged in the customary manner. By directing the powerful current of the above mentioned machine to this apparatus, the copper ball belonging to which, placed on the thermometrical tube, was at the distance of about three or four lines from the conductor, I succeeded in decomposing the water with a promptitude nearly equal to that which results from a voltaic pile of a hundred pairs of metallic plates." As generally known, this method of decomposing water is a very tedious one, and is in fact the result of an interrupted explosion, while the process of Dr. Wollaston (alluded to at A. D. 1801) is tranquil and progressive.

*Continued from THE ELECTRICAL WORLD of Dec. 12, 1891.

See "Biogr. Univ." vol. XLII., page 600; J. G. Heinze, "Neue elekt. versuche . . .," Oldenberg, 1777; Tries' claim to Van Marum's machine in Rozier, XL., 116; Prieur's extract in *Annales de Chimie*, vol. XXV., page 312; "Verhand. Genootsch. Rott." VI. for 1781 and VIII. for 1787; *Journal de Physique*, XXXI., 1787, XXXIII., 1788 (Marum en Troostwyk), XXXIV., 1789, XXXVIII., 1791, XL., 1792; "Journal du Galvanisme," XI., Cahier, page 187; *Nicholson's Journal* for March, 1799, vol. II., page 527; Harris, "Electricity," pages 62, 90, 171; Cuthbertson, "Practical Electricity," London, 1807, pages 166, 172, 197, 225; Cavallo, "Electricity," 4th ed., vol. II., page 273; "Lib. of Useful Knowledge," Electricity, page 45; Wilkinson, "Elements of Galvanism, etc., London. 1804, vol. II., pages 406, 128, 384; Teyler's "Tweede Genootschap;" Gilbert, *Annalen*, I., 239, 256; X., 121; Rozier, XXVII., 148, XXXI., 343, XXXIV., 274, XXXVIII., 109, 447, XL., 270; "Opusc. Scelti," IX., 41, XIV., 210.

A. D. 1785.—Sigaud de la Fond, professor at the College d'Harcourt in Paris, published in the latter city his "Précis historique et expérimental des phénomènes electriques," wherein he states having, as far back as 1756, made use of a circular plate machine provided with cushions and similar in shape to that which many claim to have originated with Ingen-housz and with Ramsden. (See A. D. 1779 and A. D. 1768.)

Sigaud de la Fond is also the author of "Déscription d'un Cabinet de Physique (1784), "Cours de Physique, etc." (1786), "Examen., etc." (1803) and of several treatises on medical electricity.

See: "Journal de Physique," vol. II., 1773; Figuier, "Exposition et Histoire," Paris, 1857, pp. 50, 74-76, 178; Poggendorff, vol. II., p. 927.

A. D. 1785.—In the "Nachricht von einer neuen Elektrisirmaschine des Herrn Walkiers von Saint Amand," the last named gives a description of the electrical machine presented by him in 1784 to the Belgian Academy of Sciences.

It is also described and outlined in Delaunay's "Manuel" named below, but, although very powerful in its effects, cannot be made readily available in consequence of its huge dimensions. Mr. Caullet de Veamorel suggested the feasibility of changing the cylinders from a horizontal to a vertical position.

See *Lichtenberg's Mag.*, vol. III., 1 St. p. 118; Delaunay, "Manuel, etc.," 1809, pp. 14-16.

A. D. 1785.—Adams (George), mathematical instrument maker to his Majesty, writes an enlarged edition of his "Essay on Electricity, etc.," which first appeared the year previous and wherein, as its full title indicates, he endeavors to explain the theory and practice of that science and the mode of applying it to medical purposes. He cites and illustrates many interesting experiments and also gives an Essay on Magnetism, in the treatment of which latter he acknowledges the valuable aid of Dr. J. Lorimer.

The fifth and last edition of the "Essay," which was issued by William Jones in 1799, four years after Adams' death, contains a communication on the subject of Medical Electricity by John Birch, the author of "Della Forza dell' Elettricita, etc.," Napoli, 1778.

At page 86 of the 1799 "Essay, etc.," Adams relates that, while M. Laommi Baldwin ("Memoirs of Amer. Acad.," vol. I., page 257) held the cord of his kite during the approach of a thunder storm, he "observed himself to be surrounded by a rare medium of fire, which, as the cloud rose nearer the zenith, and the kite rose higher, continued to extend itself with some gentle faint flashes." At pages 137, 186 and 222, he alludes to "Brooke's Miscellaneous Experiments and Remarks on Electricity, etc.," as well as to the Rev. Mr. Lyon's "Experiments and Observations on Electricity," and refers to the Journal of Natural Philosophy (vol. II., page 438) for Nicholson's experiments on the *plus* and *minus* of electricity.

A. D. 1785.—La Méthérie (Jean Claude de), French physicist and naturalist, becomes sole editor of the *Journal de Physique de chimie et d'histoire naturelle*, and publishes in Paris his "Essai Analytique, etc.," wherein he asserts that the electric spark results from the combination of oxygen with hydrogen.

He considers that all bodies exist in an electrical or magnetical condition, that we are only a temporary aggregation of molecules of matter governed in different ways by nature's laws, and that excitability is produced by galvanic action resulting from the superposition of nervous and muscular fibres.

He is also the author of very interesting treatises on animal electricity communicated to the *Journal de Physique* (vol. XLII., pp. 252, 255, 292), and of which an account is given in Sue's "Histoire du Galvanisme," Paris, 1802, vol. I., pp. 64–68. The last named work also gives, at page 80, an account of the letter on "Galvanism" sent to Mr. De La Méthérie by Mr. Leopold Vacca-Berlinghieri (*Journal de Physique*, vol. XLI., page 314).

See "Biographie Générale," vol. XXIX., page 209; Rozier, XLI., 437; Delaunay, "Manuel, etc.," 1809, page 15, also Delaunay's letter in *Phil. Mag.*, vol. XXVII., page 260; C. H. Wilkinson, "Elements of Galvanism," London, 1804, vol. I., page 62, vol. II., page 9; "Opus. Scelti," XXI., 373; *Journal de Physique et Chimie*, vols. LIII., LIV., Pluviose, an. XI., page 161, also page 157 for letter sent him by Giuseppe Izarn; *Ann. di Chim. di Brugnatelli*, vol. XIX., page 156; Aubert, "Elektrometische Flasche," Paris, 1789.

A. D. 1787.—Brard (Cyprien Prosper), French mineralogist, first observes that some crystals of axinite (consist) ing mainly of silica, alumina, lime and peroxide of iron become electric by heat.

See Gmelin, article "Electricity, etc.," vol. I., p. 319; Larousse, "Dict. Univ.," vol. II., p. 1,205; Thomas, "Dict. of Biog.," vol. I., p. 429; "Enc. Brit.," 8th ed., vol. VIII., p. 530; Brard, "Manuél du Minéralogiste, etc.;" Bordeaux Academy of Sciences Report for 1829, p. 39, and for 1838, p. 84—the latter containing Mr. Gachett's observations on one of Mr. Brard's meteorolites.

A. D. 1787.—Haüy (Le Père René Just), native of Picardie and member of the Académie Royale des Sciences, publishes an abridgment of the doctrines of Æpinus (A. D. 1759 (under the title of "Exposition raisonnée de La Théorie de l'Electricité et du Magnétisme." He was doubtless the first to observe that in all minerals the pyro-electric state has an important connection with the want of symmetry of the crystals, and no proof of the extent to which he directed his investigations in that line can more readily be had than by consulting the Encyclopædia articles relative to the pyro-electricity of boracite (borate of magnesia), of prehnite (silica, alumina and lime), of mesotype (hydrated silicate of alumina and of lime or of soda), of sphene (silica, titanic acid and lime), calamine (silicate of zinc) and of Siberian topaz.

At pages 480, 481 of his "Outline of the Sciences, etc.," London, 1830, Dr. Thomas Thomson states:

There is a hill of sulphate of lime, called Kalkberg, situated near Lunebourg, in the duchy of Brunswick, in which small cubic crystals are found. These cubes are white, have a specific gravity of 2.566, and are composed of two atoms of boracic acid combined with one atom of magnesia. They are distinguished among mineralogists by the name of *boracite*. If we examine the cubic crystals of boracite, we shall find that only four of the solid angles are complete, constituting alternate angles placed at the extremity of two opposite diagonals at the upper and lower surface of the cube. The other four solid angles are replaced by small equilateral triangles. When the boracite is heated all the perfect solid angles become charged with *negative* electricity, while all the angles replaced by equilateral triangles become charged with *positive* electricity. So that the boracite has eight poles; four positive and four negative. Those are obviously the extremities of four diagonals connecting the solid angles with each other. One extremity of each of these diagonals is charged with positive and the other extremity with negative electricity. In general, the electricity of boracite is not so strong as that of the *tourmaline*. This curious law of the excitability of the boracite and of its eight poles was discovered by Haüy in 1791. (Haüy's "Minéralogie," 260, Second Edition.)

Axinite, *mesotype*, and the *silicate of zinc*, are also minerals which become electric when heated, and which, like the *tourmaline*, exhibit two opposite poles, the one positive, the other negative. It is not every crystal of axinite and mesotype which possesses this property, but those only which are destitute of symmetry; that is to say, one of whose extremities is shaped differently from the other. No doubt this remark applies also to the silicate of zinc; though the crystals of that mineral being usually acicular it is not so easy to determine by observation the degree of symmetry which they may possess.

The *topaz*, *prehnite*, and the titaniferous mineral called *sphene*, are also capable of being excited by heat, and have two opposite poles like those already mentioned.

Haüy also made the most extensive and accurate observations known upon the development of electricity in minerals by friction. Detailed lists of the different classes of minerals, as well as the conclusions arrived at through various experiments, are given in the "Encyclopedia Britannica," vol. VIII., 1855, pp. 538, 539, while, at pages 558 and 529 of the same work are to be found accounts of his observations on the electricity of the *tourmaline* as well as a description of the different electroscopes employed in his many experiments.

See Priestley, "History of Electricity," 1767, pp. 314–326; Gmelin's "Chemistry," vol. I., p. 319; Noad, "Manual," pp. 27–31; also article "Electricity" in "Library Useful Knowledge," pp. 3, 54, 56; M. Lister, "Collection Académique, tome VI.; "Société Philomathique," An. V., p. 34, An. XII. p. 191; "Mém. du Museum d'Hist. Nat.," vol. III.; "Mém. de l'Institut," An. IV., tome I, "Sciences Math. et Phys." p. 49; "Mém. de l'Académie," 1785, Mem. p. 206; *Philosophical Magazine*, vols. XX., p. 120, XXXVIII., p. 81; Thomas Thomson, "Hist. of the Roy. Soc." London, 1812, pp. 180, etc.; Young's Lectures, London, 1807, vol. II.; Haüy, "Traité Elémentaire de Physique," chap. VI., "Electricity," and chap. VII. "Magnetism"; Experiments of J. L. Treméry (author of "Observations sur les Aimants Elliptiques," recorded in *Journal des Mines*, vol. VI., for 1797, also in *Jour. de Phys.*, vols. XLVIII., and LIV.,) and of M. De Nelis, some of whose observations are given in the *Phil. Mag.*, vol. XLVIII., p. 127, and in the *Jour. de Phys.*, vols. LXI., p. 45, LXII., p. 150, LXIII., p. 147, LXIV., p. 130, LXVI., pp. 336, 456, as shown and illustrated at pp. 153–162 of Delaunay's "Manuel, etc.," of 1809; "Séances de l'Acad. de Bordeaux" for 1835 for Mr. Vallot's report on the difference existing between the chalcedony and the tourmaline. Regarding the latter, consult S. Rinmann ("K. Schwed. Akad. Abh.," XXVIII., 46, 114); C. Rammelsberg, "Die Zuzam . . . und Feldspaths;" Mr. Magellan's edition of Cronstedt's Mineralogy for Steigliz's tourmaline; Cesare G. Pozzi, on the Tourmaline; H. Von Meyer ("Archiv. . . . Ges. Natural," XIV., 3, p. 342); Mr. Lechman (Berlin Academy Reports); Carl Von Linné (Linnæus), "Flora Zeylonica," Stockholm, 1747; Mr. Leymarie (Toulouse Acad. Reports); J. K. Wilcke ("Vetensk. Akad. Handl.," 1766 and 1768); Jos. Muller, "Schreiben . . . Tourmaline," Wein, 1773; F. J. Muller von Reichenstein, "Nachr. . . . an Born," Wien, 1778; H. B. de Saussure ("Jour. de Paris"), 1784; Louis Delaunay's letter on the tourmaline, 1782; D. G. Fischer's works, published at Mosk, 1813, 1818; J. D. Forbes ("Edinb. Trans.," Vol. XIII.), 1834.

The Thermal Emissivity of Thin Wires in Air.*

BY W. E. AYRTON, F. R. S., AND H. KILGOUR.

In 1884 it was observed experimentally that whereas the electric current required to maintain a *thick* wire of given material, under given conditions, at a given temperature was approximately proportional to the diameter of the wire raised to the power three halves, the current was more nearly proportional to the first power of the diameter if the wire were *thin*. When this difference in the behavior of a thick and thin wire was first noticed it was regarded as being quite unexpected. But, as pointed out by one of us in the course of a discussion at a meeting of the Royal Society, the unexpected character of the result was due to people having assumed that the loss of heat from radiation and convection per square centimetre of surface per one degree excess temperature was a constant, and independent of the size and shape of the cooling body.

The very valuable investigations that have been made on emissivity by Mr. Macfarlane, Prof. Tait, Mr. Crookes, Mr. J. T. Bottomley, and by Mr. Schleiermacher had for their object the determination of the variation of the emissivity with changes of the surface and with change in the density of the gas surrounding the cooling body, but it was not part of these investigations to determine the change in the emissivity that is produced by change in the shape and size of the cooling body. Indeed, so little has been the attention devoted to the very large change that can be brought about in the value of the emissivity by simply changing the dimensions of the cooling body, that in Prof. Everett's very valuable book of Units and Physical Constants the absolute results obtained by Mr. Macfarlane are given as the "results of experiments on the loss of heat from blackened and polished copper in air at atmospheric pressure," and no reference is made either to the shape or to the size of the cooling body.†

The laws which govern the loss of heat from thin cylindrical conductors have not only considerable scientific interest in showing how the shape of a body affects the convection currents, but they are of especial importance to the electrical engineer in connection with glow lamps, hot-wire voltmeters, fuses, etc. We, therefore, thought it desirable to ascertain the way in which the law of cooling for thick wires, which involved the diameter raised to the power three halves, passed into the law for the cooling of thin wires, involving only the first power of the diameter. For this object, the investigation described in the paper was commenced at the beginning of 1888, and the emissivity was measured of nine platinum wires, having the diameters of 1.2, 2.0, 2.9, 4.0, 6.0, 8.1, 9.3, 11.1, and 14 mils, or thousandths of an inch.

Suspecting that some of the published results concerning the currents required to fuse wires had been much influenced by the cooling action of the blocks to which the ends of the wires were attached, we started by making a calculation of the length necessary to give to our wires, so that the loss of heat by conduction should not introduce any important error into the determination of the emissivity. To do this it was necessary to calculate the distribution of temperature along a wire through which a steady current was flowing and from which heat was lost by radiation, convection and conduction, and it was further necessary to improve on the calculation one of us had published on this subject in the *Electrician*, for 1879, by taking into account the fact that the emissivity, as well as the thermal and electric conducting power, of the wire differed at different points in consequence of the difference of temperature.

Until we had completed the experiments described in this paper we could, of course, only employ in this calculation values that we had guessed at as being something near the truth for the emissivity of platinum wire for different diameters and at different temperatures. Hence, after the completion of the experiments, we took up the mathematical investigation again, substituting for the emissivity such a function of the diameter of the wire and the temperature of the point as we had experimentally found it to be. Section IV. of the paper contains the investigation by which we finally arrived at the calculated distribution of temperature along the wire, and we have to express our sincere

* Abstract of a paper read before the Royal Society, Nov. 19, 1891.

† [Nov. 19, 1891.—Since this paper was sent in to the Royal Society a new edition of this book has appeared, and, in consequence of a suggestion made to Prof. Everett, the word "balls" has been added after the word "upper" in the new edition as well as the following paragraph:—

"INFLUENCE OF SIZE.

"According to Prof. Ayrton, who quotes a table in 'Box on Heat, the co-efficient of emission increases as the size of the emitting body diminishes, and for a blackened sphere of radius r centimetres may be stated.

$$.0004928 + \frac{.0003909}{r}.$$

"The value of r in Macfarlane's experiment was 2 inches."]

thanks to Professor Henrici (whom we consulted as to the best method of practically solving the rather complex differential equation arrived at) for the warm interest that he has taken in the mathematical treatment of the subject, and for the many suggestions which he has made, and which have enabled us to arrive at the mathematical solution given in the paper.

Each wire to be tested was stretched along the axis of a water jacketed cylinder 32.5 centimetres long, the inner surface of which was blackened and kept at a constant temperature by a stream of water flowing through the jacket. The rate at which heat was lost by any one of the wires was measured by the product of the current passing through it into the P. D. (potential difference) maintained between its ends, while the ratio of the P. D. to the current gave the resistance of the wire and, therefore, its temperature. Experiments were in this way made with various currents flowing through each of the nine wires.

As the variation of resistance with temperature is known to vary with different specimens of platinum, experiments were separately made to determine the actual law of variation of resistance with temperature up to 300 degrees C. for each piece of wire that had been employed in the emissivity experiments.

In this later determination various thermometers were used, and the subsequent comparison of these thermometers with a Kew standard thermometer involved a vast amount of labor, from the fact that it is, or at any rate was not possible three years ago, to purchase from the Kew Observatory a standard thermometer reading from, say, 200 degrees to 300 degrees C., with a short, wide chamber at the base in which the mercury expanded below 200 degrees C. All that could be obtained was a long thermometer which had been carefully tested between 0 degree and 100 degrees C., and the remainder of whose tube had been simply calibrated for uniformity of bore. The consequence was that when we desired to compare one of our thermometers reading, say, from 200 degrees to 300 degrees C., with the Kew standard their bulbs were very far apart when both were immersed in the oil bath, and with the tops of the mercury columns just above the surface of the oil. A short description is given in the paper of the devices employed to overcome this difficulty and which enable an accurate comparison to be made between the thermometers.

On examining the curves accompanying the complete paper which show the emissivity for each temperature for each of the nine wires we see that:

1. For any given temperature the emissivity is the higher the finer the wire.

2. For each wire the emissivity increases with the temperature, and the rate of increase is the greater the finer the wire. For the finest wire the rate of increase of emissivity with temperature is very striking.

3. Hence the effect of surface on the total loss of heat (by radiation and convection) per second per square centimetre, per one degree C. excess temperature, increases as the temperature rises.

On comparing the loss of heat from the wire of 1.2 mils diameter when at 300 degrees C. with that from the wire of 6 mils diameter when at 15 degrees C., both being in an inclosure at 10 degrees C., we see that the former loses per square centimetre of surface per second not

$$\frac{300 - 10}{15 - 10}, \text{ or } 58 \text{ times}$$

as much heat as the latter, as it would if the emissivity were the same; but, instead,

$$60 \times 58, \text{ or } 3{,}480 \text{ times}$$

as much heat; arising from the fact that the emissivity, that is, the number of calories (gramme C. degree) lost per second per square centimetre of surface per one degree C. excess temperature of the 1.2-mil wire at 300 degrees C., being 60 times as great as that of the six-mil wire at 15 degrees, the latter varying very rapidly with the temperature near 15 degrees C.

From the curves the accompanying table has been drawn up, giving the emissivities of the various wires at eight useful temperatures.

We find that the emissivity of platinum wires of different diameters at the same temperature can be very fairly expressed by a constant plus a constant into the reciprocal of the diameter of the wire. For example, we find that

At 100° C. $e = 0.0010360 + 0.0120776\ d^{-1}$ (1),
At 200° C. $e = 0.0011113 + 0.0143028\ d^{-1}$ (2),
At 300° C. $e = 0.0011353 + 0.016084\ d^{-1}$ (3),

where d is the diameter of the wire in mils, or thousandths of an inch.

The emissivities have been calculated in calories lost per second per square *centimetre* per one degree C. excess temperature, in order that they may be compared with the emissivities obtained by other experimenters, but we prefer to speak of the diameters of the wires in *mils*, since a wire of one mil is about the finest that is drawn commercially. Hence the statement that the diameters of wires are one, two or three mils is more suggestive to an engineer than saying that they are 0.0254, 0.0508, or 0.0762 millimetre.

The statement, not unfrequently made, that the current required to maintain a wire of a given material at a given temperature above that of the surrounding envelope is proportional to the diameter of the wire raised to the power three halves is equivalent to stating that the emissivity is independent of the diameter. Now, from the three formulæ (1), (2), (3), given above for e, we may conclude—

That for a temperature of 100 degrees C. the value of d in the formula

$$e = 0.0010360 + 0.0120776\ d^{-1}$$

must be something like 220 mils, or 5.6 millimetres, in order that the neglect of the second term may not make an error in e of more than five per cent., and something like 1.15 inch, or 29.3 millimetres if the error is not to exceed one per cent.

That for a temperature of 200 degrees C. the value of d in the formula

$$e = 0.0011113 + 0.0143028\ d^{-1}$$

must be something like 224 mils, or 6.2 millimetres, in order that the neglect of the second term may not make an error in e of more than five per cent., and something like 1.28 inches, or 32.5 millimetres, if the error is not to exceed one per cent.

And that for a temperature of 300° C. the value of d in the formula

$$e = 0.0011353 + 0.016084\ d^{-1}$$

must be something like 267 mils, or 6.8 millimetres, in order that the neglect of the second term may not make an error in e of more than five per cent., and something like 1.39 inches, or 35.3 millimetres, if the error is not to exceed one per cent.

Generally, then, we may conclude that to assume that the emissivity is a constant for wires whose diameters vary from a small value up to one inch is to make a large error in the case of the greater number of the wires, and an error of hundreds per cent. in the case of some of them.

Diameter of wire in		Emissivities.							
Mils.	Millimetres.	40° C.	60° C.	80° C.	100° C.	150° C.	200° C.	250° C.	300° C.
1.2	0.0305	0.008230	0.009560	0.010300	0.010846	0.011875	0.012783	0.013625	0.014400
2.0	0.0508	0.005950	0.006860	0.007500	0.007900	0.008600	0.009070	0.009480	0.009850
2.9	0.0737	0.002193	0.003336	0.004086	0.004552	0.005095	0.005379	0.005628	0.005845
6.0	0.1524	0.002460	0.002660	0.002806	0.002930	0.003212	0.003460	0.003666	0.003837
8.1	0.2057	.....	.....	.....	0.002804	0.002939	0.003076	0.003217	0.003352
9.3	0.2362	.....	.....	.....	0.002297	0.002448	0.002586	0.002718	0.002843
11.1	0.2819	.....	.....	.....	0.002053	0.002216	0.002363	0.002490	0.002608
14.0	0.3556	.....	.....	.....	0.001894	0.002027	0.002136	0.002224	0.002286

The wire of 4 mils diameter is omitted from the table, as the experiments showed that its specific resistance was much greater, its temperature coefficient much smaller, and its emissivity much smaller than if it had been of platinum. This piece of wire probably therefore contained iridium or silver.

Using the formula (3) which we have arrived at for determining the emissivity of platinum wires of different diameters at 300 degrees C., it follows that to maintain a platinum wire 0.75 mil in diameter at 300 degrees C. would require a current density of 331,000 ampères per square inch, and if the emissivity of a copper wire of the same diameter and at the same temperature may be taken as being the same, it follows that to maintain a copper wire 0.75 mil in diameter at 300 degrees C. would require a current density of 790,000 ampères per square inch.

Alternate Current Ohmmeters.*

BY JAMES SWINBURNE.

In direct current work ohmmeters have never come into extended use because a voltmeter and ampèremeter

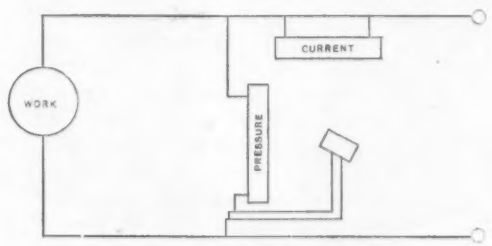


FIG. 1.—ALTERNATE CURRENT OHMMETER.

give all the information necessary in most cases. The ohmmeter was brought forward by Sir William Thomson for use in central stations as a lamp counter. It has the advantage over most ampèremeters in that it tells how many lamps are in use, even if the prèssure varies. In the case of alternate currents, however, a difficulty arises. Those in charge of the station cannot tell how many lamps are in use by inspection of a voltmeter and ampèremeter. The load can be found only by means of a wattmeter in its ordinary form, or in one of its numerous disguises.

An instrument that measures the effective resistance may therefore be of use—that is to say, an instrument which is an alternate current analogue to the direct current ohmmeter.

Effective resistance is not the same quantity as impedance. Impedance is the ratio of the effective electromotive force to the effective current, and is seldom of any importance in real work. There are evidently two quantities R and r, such that $E^2/R = P$ and $C^2r = P$ are true when E and C are the effective electromotive force and current and P the power. There are practical difficulties in making instruments to measure r unless the current is very small, though in principle they are the same as those for measuring P.

Fig. 1 shows one form of alternate current ohmmeter. It is like a direct current ohmmeter, but the magnetized needle is replaced by a small coil which is in series with the fine wire or pressure coil. The moving coil has no external control, so that it can take up any position. The position will be such that the couple tending to turn the moving coil parallel to the fine wire coil is equal and opposite to the

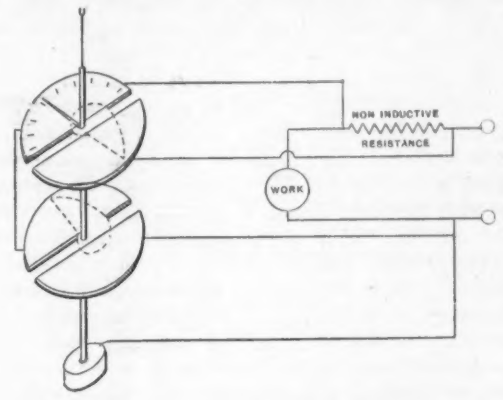


FIG. 2.—ALTERNATE CURRENT OHMMETER.

couple due to the current coil. The couple due to the pressure coil is $\frac{1}{T}\int e^2 dt$, and the couple due to the current coil is $\frac{1}{T}\int ec\,dt$, so the reading

$$R = \frac{\int e^2 dt}{\int ec\,dt}.$$

The effective electromotive force is $\sqrt{\frac{1}{T}\int e^2 dt}$. The square of the pressure divided by the effective resistance is thus

$$\frac{1}{T}\int e^2 dt \times \int ec\,dt \;/\; \int e^2 dt = \frac{1}{T}\int ec\,dt,$$

so that the instrument can be graduated to read the number of lamps in use. Waste in leads will be indicated as if a corresponding number of lamps were in circuit.

In a wattmeter in which the fine wire circuit is put in shunt to the working circuit only, there is an error due to the pressure coil circuit being in series with the current coil, so that there is a reading even when the working circuit is open. If the pressure coil is put in shunt across the power circuit and current coil it includes the fall over the current coil. Corrections have to be made, therefore, unless the instrument is compensated in the way described in my British Association paper in 1887. In the direct current ohmmeter, however, this error does not come in. The reading due to the pressure field, modified by the small current in the current coil when the working circuit is open, is taken as infinity, and the rest of the scale graduated accordingly. Or, in other words, an ohmmeter either includes the conductivity of the pressure circuit or the resistance of the current circuit in its readings; but as these are constant they can be allowed for in graduating the scale. The chief drawback to the instrument illustrated is the difficulty in leading the instrument to and from the moving coil. Even fine wires exert some force when twisted. It is, therefore, necessary to turn the suspensions, making them follow the movement of the coil, so that the instrument is not direct reading, or else mercury contacts and a fibre suspension must be used.

If the moving coil is put in series with the current coil instead of with the pressure coil the forces are proportional to $\frac{1}{T}\int ec\,dt$ and $\frac{1}{T}\int c^2 dt$, so that the reading r multiplied by C^2 gives the power spent.

Fig. 2 is a diagram of an electrostatic instrument. The suspended system consists of a thin rod with two light plates. These are cut and placed between half discs, so that as the moving system turns the torque due to one cell increases, and that due to the other decreases. The position finally taken up by the needle thus depends on the ratio of the couples exerted, not on their magnitude. The electrometer is shown coupled to a circuit. The moving system is suspended by a fibre, and contact is made through acid, in the usual way. When connected, as shown, the couple due to the upper cell is proportional to $\frac{1}{T}\int (e+c)^2 - e^2 dt$, and that of the lower cell to $\frac{1}{T}\int e^2 dt$, so that the reading r multiplied by E^2 is $2P + \frac{1}{T}\int c^2 dt$, so that the instrument is not theoretically correct. It can be made theoretically correct by coupling differently, or by adding a second upper cell to give a negative couple proportional to $\frac{1}{T}\int c^2 dt$. Neither of these alterations is necessary, however, for such an instrument can be made

* From *Industries*.

so sensitive that when E is a few thousand volts, c is inappreciable in comparison with it. The lower cell must, of course, be made to give a couple which is comparable with that of the upper cell.

Another simple way of explaining the action of this instrument is to say that the upper cell measures watts and the lower divides by the square of the effective pressure. Multiplying the reading by the square of the effective pressure thus gives the power in watts. This may sound an involved method, but it avoids the introduction of a troublesome resistance in series with the working circuit. For instance, in a 2,000-volt station resistances causing losses of, say 50 volts, cannot be left in the various circuits, as that would mean a loss of 2½ per cent. of the station output. An instrument whose needle is suspended by a fibre with no torsion control can be made very much more sensitive, and may thus overcome the difficulty. The lower cell may be coupled to divide the power by the square of the effective current, so as to give r so that $C^2r = P$; but this arrangement does not promise to be useful.

It must not be forgotten that all arrangements for measuring alternating power have an error, which may, however, be rendered inappreciable. If electrostatic methods are used, a non-inductive resistance must be arranged in series with the main circuit, to give a pressure proportional to the current, and if electromagnetic arrangements are used, the pressure coils are in circuit with a non-inductive resistance. Thus, whether an electrostatic wattmeter, an electromagnetic wattmeter, or a split dynamometer, which is a faulty modification of the ordinary wattmeter, or three electrostatic or other voltmeters, or several ampère meters be used, or any combination of these, exactly the same error comes in. It is due to the time constant of the almost non-inductive resistance. With care in design this error may be rendered inappreciable, but I call attention to it because it is often supposed that the three-voltmeter arrangement published recently avoids the difficulty. The split dynamometer is also supposed to be free from this error. It really involves it, and involves other errors which are peculiar to it, and infinitely more important. The three-voltmeter method has been taken much more seriously than I think it deserves, probably because Messrs. Ayrton and Sumpner read a paper at the Royal Society on the subject. It seems to me to be more of a scientific curiosity than anything else, as a method involving readings of three instruments and calculations must be inaccurate compared with the readings of a single wattmeter, which takes the same measurements and does the calculations automatically and gives the reading direct.

A New Alternator.*

The alternator we illustrate herewith has been constructed by Mr. Rankin Kennedy, of Glasgow, and belongs to that class in which both the exciting and the generating coils are fixed, the revolving part consisting of laminated iron inductors. Machines of this class have been made by many inventors, such as R. Knight, Wheatstone, Henley, and lately by Kingdon on a large scale. Such dynamos have also been designed by Mordey and Forbes.

The points of novelty in this new machine are chiefly the

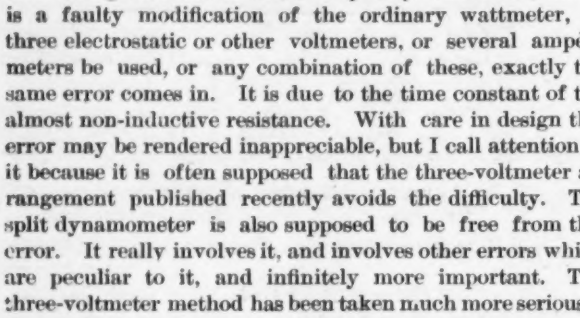


Fig. 1.—Construction of Field Magnet Blocks.

arrangement of the coils of wire and the construction of the magnetic circuits, whereby only two exciting coils and two generating coils are required, however large it may be made, and however great may be the pressure and frequency of the alternating current required. The machine very much resembles a transformer in its parts, and is about as simple in construction. The iron field magnet portions surround the copper coils, which are simple rings of insulated wires; the inductors are carried on gun metal wheels, and in revolving alternately open and close the magnetic circuit round the copper coils, thus inducing current in them. There is no reversal of magnetism in any part of the operation of the machine, only a simple rising and falling of the magnetic flow without reversal. The iron is made of very ample sections, so that the induction is never high, and never falls to zero. The excitation is constant, but the induction varies with the position of the inductors. In a machine recently built, and which is illustrated in Figs. 1, 2, 3 and 4, the E. M. F. was 8 volts per turn of generating coil, the speed 750, the excitation 15 ampères under 35 volts; the inductors 6 on each side; the total pressure was 2,400 volts; with 300 turns of wire on generating coil the output was 24,000 watts. Fig. 4 is a general view of the machine. Fig. 2 is a view of the inductors on the shaft. Fig. 3 is a view of one pair of coils, and Fig. 1 shows the construction of one of the field magnet blocks.

There are two pairs of coils in the machine, and two sets of inductors placed as shown in Fig. 2. The generating coil is wound first and insulated, then the exciting coil is wound over that, and the whole is insulated and fixed in the machine in the recesses formed in the field block, as shown in Fig. 1. By using two pairs of coils and two sets of inductors, and exciting the coils so that the field blocks are magnetized with a pole in the middle and similar poles at each end, as marked in Fig. 1, when the two exciting coils are in "series" with each other any inductive effects on the one exciting coil are exactly and entirely neutralized by those effects on the other exciting coil. The two generating coils can be coupled either in series or in parallel, but

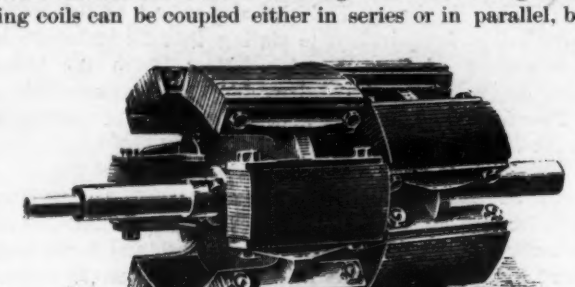


Fig. 2.—Inductors on the Shaft.

the exciting coils must always be in series. This machine is exceedingly simple and inexpensive to build, and there is no difficulty with insulation or in constructing them for any pressure or frequency required. In large dynamos there are four pairs of coils and four sets of inductors.

In the machine illustrated the inductors are 21 inches in diameter, the coils being 21¼ inches inside diameter; the electromotive force of the generating coil is about 1.35 volts per foot working at very moderate inductions and at moderate speed, and this can safely be raised to two volts per

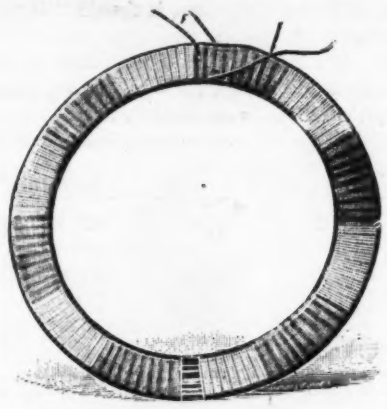


Fig. 3.—One Pair of Coils.

foot. For low pressure alternating currents this machine is equally applicable.

In central stations for electric lighting supply in districts where the stations are surrounded by consumers, it is advisable to use low pressure dynamos, so as to supply the immediately surrounding neighborhood direct from the dynamos, and to supply the distant consumers through step-up transformers. As a motor this machine works well, but has to be brought up to synchronism, like all other synchronizing alternators.

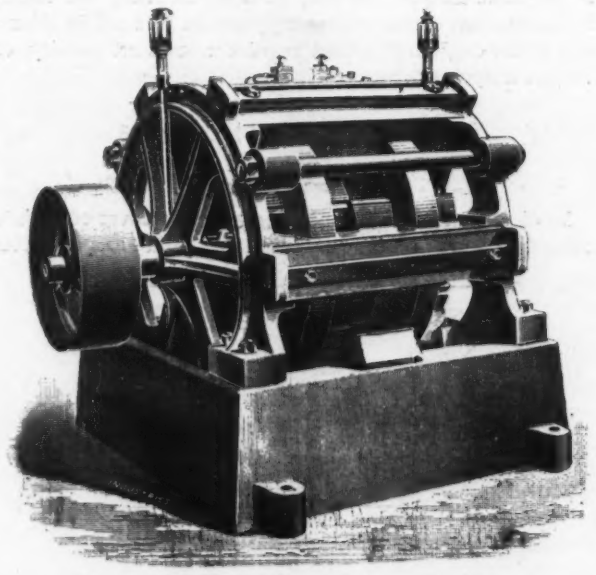


Fig. 4.—General View of the Machine.

A machine with inductors four feet in diameter gives an output of 150,000 watts (100 volts 1,500 ampères) at a speed a little over 200 revolutions per minute. This is suitable for low pressure distribution near the station, and high pressure at a distance by means of step-up transformers.

In Fig. 3 the terminals of the exciting coil, and the terminals of the generating coils are shown. By using only two coils in large slow speed machines it is expected that the complications hitherto met with in large machines will be obviated, most of them requiring two generating coils for each period per revolution. An ordinary machine making one revolution per second would require 200 coils to give a frequency of 100 per second. The machines are specially designed for continuous running at central generating stations.

*From *Industries*.

For a Christmas Present.

A correspondent asks us to suggest something for him to send as a Christmas gift to a friend.

Books are always an appropriate present. Their value is far in excess of their slight cost. This is particularly true of scientific works. In this age of electricity every one is interested in informing himself regarding the practical applications of this youngest and most hopeful of the arts.

What could be more fitting, then, for a Christmas or a New Year gift than a copy of one of the many excellent works on electricity?

The following are a few that might be mentioned:

Guillemin's recently issued "Electricity and Magnetism," edited by Prof. Silvanus P. Thompson, 976 pages and 600 illustrations, price $8.

Urbanitzky's "Electricity in the Service of Man," edited by R. Wormell, 877 pages and 836 illustrations, price $6.

James D. Reid's well known and standard "Telegraph in America," 894 pages and beautifully illustrated; price, cloth, $5; Russia, $7.

Martin & Wetzler's "Electric Motor and its Applications," new edition, with an appendix by Dr. Bell, 325 pages and 354 illustrations, price $3.

Urquhart's "Electric Light, Its Production and Use," 395 pages and 145 illustrations, price $3.

The same author's "Dynamo Construction," 352 pages, fully illustrated, price $3.

Carl Hering's "Dynamo-Electric Machines," 279 pages and 59 illustrations, price $2.50.

The same author's "Wiring Computer," price $1.

Kempe's "Electrical Engineers' Pocketbook of Modern Rules, Formulæ, Tables and Data," 348 pages and numerous illustrations, price $1.75.

Dr. Atkinson's "Electric Lighting," 260 pages, illustrated. price $1.50.

Pope's "Modern Practice of the Electric Telegraph," fourteenth edition, entirely rewritten, 234 pages, 185 illustrations, price $1.50.

Prof. Silvanus P. Thompson's "Elementary Lessons in Electricity and Magnetism," 456 pages and 171 illustrations, price $1.25.

The same author's "Lectures on the Electromagnet," 287 pages, 75 illustrations, price $1.

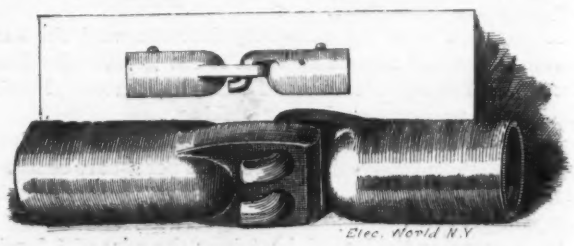
"Walker's Practical Dynamo Building for Amateurs," 63 pages, illustrated, price 75 cents.

As most readers of this journal know, any of these books, or any other electrical book or books published, will be forwarded to any address in the world, charges prepaid, on receipt of the price, by the W. J. Johnston Company, Limited, Times Building, New York.

May we add, in conclusion, that a year's subscription to The Electrical World, at $3, makes a most excellent present, and the recipient has 52 different opportunities during the year of recalling the thoughtfulness of the donor in sending the paper.

Threading Rod for Underground Conduits.

A device called "threading rod for underground conduits," recently patented by Mr. F. G. Bolles, of Washington. D. C., is one of those extremely valuable appliances



Joint for a Conduit Needle.

which may seem of small importance on account of their appearance, but which nevertheless seem indispensable when once they are put into use.

The illustration herewith gives a good idea of this coupling device. It consists of a threading rod, made either of wood or metal, at each end of which is fixed the connecting pieces. Instead of using sections of gas pipe, which heretofore has often been necessary, these sections are inserted in the conduit and the connection made by simply inserting the projection piece having two hooks into the corresponding holes of the other end of the connection. By this arrangement it is possible to thread a wire through a section of conduit 450 feet in 15 minutes instead of one and three-quarters hours as heretofore. A great saving in expense of labor and material is also realized, and Mr. Bolles' invention is sure to prove very useful in underground practice.

Lighting a Room with Reflectors.

A very interesting lighting experiment was witnessed at the Eden Musée one evening last week. This establishment has long enjoyed the advantages of its own electric light plant; but trouble has been experienced in securing a satisfactory light in the large room where the stage performances take place.

At the suggestion of Count Tessel, the Scott Electrical Company installed four of its new automatic arc focusing

lamps at as many different points around the gallery; these lamps received current from the regular incandescent circuit, and their burning was remarkably steady. The light effect produced was surprising. While there was no glare, owing to the use of lenses, the entire auditorium was flooded with light of the most brilliant character. The incandescent lamps burning at the same time were not interfered with in any way. It is proposed to permanently install four of these reflectors in large vases, which will conceal the source of the light, but at the same time throw ts powerful rays in all directions.

Lightning Guard for Electric Light Installations.

The accompanying illustration, for which we are indebted to the *Electrical Review*, of London, shows one of the latest forms of Dr. Lodge's lightning guards.

The current enters at one end of the axis, circulates through the two thick wire highly insulated coils, and leaves by the other end of the axis. But in so doing it has passed three pairs of brass collars which clamp between them a square of mica coated with tinfoil, the corners of which come very close to an outer metal case connected with the ground. When lightning therefore attempts to follow the current, it spits off from one or other of the corners of the first tinfoil to earth, thereby striking a momentary arc, which is destroyed the next instant by the fusion of that corner of tinfoil. The other corners are ready for a future occasion.

The air gap necessary between the brass collars and the outer case must depend on the voltage of the installation for which it is designed, and the length of arc accordingly to be expected. At present it has only been tested up to about 100 volts.

A New Electrical Carriage.

Electrically propelled vehicles are among the many conveniences which novelists and fiction writers have ascribed to future ages, while practical inventors have given their attention to subjects that bring them more satisfactory results, such as street car work. A departure from this line of thought is afforded in the electrical carriage invented by William Morrison, of Des Moines, Ia., an illustration of which is shown herewith. The motive power is obtained from 24 accumulator cells placed under the seats, while the motor itself is on the rear axle. The winding of the motor is so arranged that a reversal of the current will cause the carriage to run backward as easily as forward, while the steering apparatus is arranged simply and effectively, as will be seen by the cut.

This carriage has been in practical operation in the streets of Des Moines for some time, and will soon be seen in Chicago.

From the satisfactory results obtained from this mode of locomotion the day does not seem so very far distant when carriages as well as other vehicles will be moving around our streets propelled by electric motors that receive their current from concealed batteries, and therefore effect a further emancipation of the millions of animals now performing this service.

The Paris Electric Underground Railway.

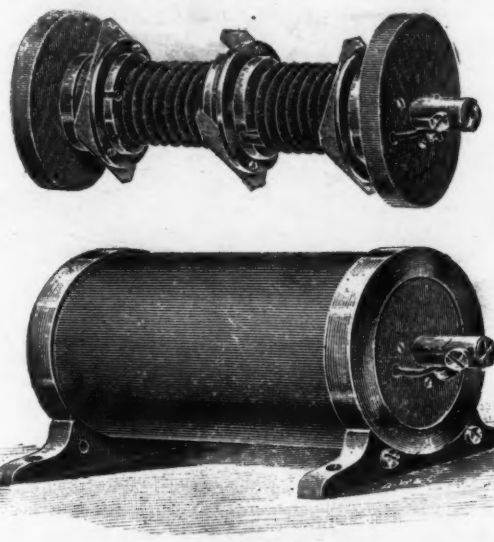
On Aug. 10 last the Prefecture of the Seine posted a notice throughout Paris respecting the establishment of an underground tubular tramway, using electric traction, running from the Bois de Boulogne to the Bois de Vincennes. Hitherto, says a London contemporary, referring to this matter, the inquiry opened on Aug. 17, instead of exhibiting the usual difficulties connected with Parisian public affairs, has met with much cordiality. In connection with the ill-success of the mechanical traction tramway running from Belleville to the Place de la République, the moment is opportune for placing parallel with this the advantages and conveniences of electric traction, following on the decisive experiment of the City and Southwark Railway. It is now possible to follow the project as far as it has been accepted by the Municipal Council.

The system adopted is that presented by M. J. B. Berlier. The concession includes an underground tunnel nearly following the course of the Seine, and traversing Paris at its greatest breadth. There are to be six stations, and a generating depot at the end of the line. We need devote no space here to the construction of the tunnel, as it will be very similar to that of our London electric railway.

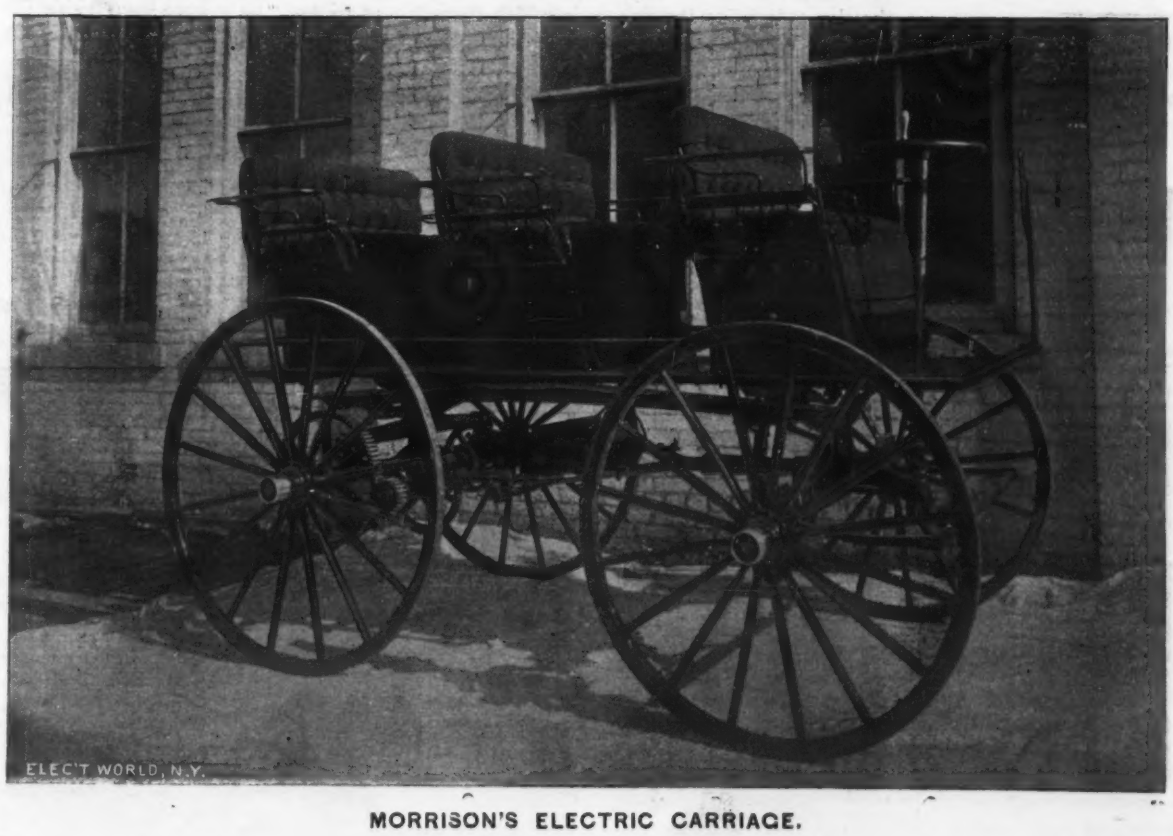
The lighting question is, of course, of great importance, and is to be solved by the creation of a special service established at the works at the end of the line, and will include arc lighting for the stations and incandescent lights for the carriages, signals, and for the general service of the tunnel throughout its length. The electricity generating machinery will be duplicated, so as to provide against breakdowns.

Electric traction will have a preponderating part to play in this new scheme, and it must not be forgotten that electricity has, in many instances, dethroned cable traction, and as Paris has no application of this nature M. Berlier's plan is necessarily of great interest.

The following are M. Berlier's arrangements for the position of the conductors. The transversal sleepers of injected wood are placed a metre apart; on these run two parallel ways formed of rails 30 kilos to the running mètre. In the middle of each line of metals is placed a central rail insulated by india-rubber plates from the sleepers to which it is fastened. The conductor, thus insulated and perfectly sheltered, is protected against all loss due to atmospheric causes, which are always present in aerial lines. The motor carriage carries under its framework two motors established on the same circuit, to the shafts of which are directly attached the wheels of the vehicle. The motors are each of 25 h. p., and will be regulated for proportionate speeds and for stoppages by a rheostat regulator, while the reversing of the machinery will be effected by a special commutator. A similar arrangement will be adopted for the interior lighting of the carriages, in addition to which, during the journey, all the doors will be closed by an electric bolt under the charge of the engine driver. On arriving at a station they will be released and will open automatically. Our contemporary also gives a mass of statistics, basing its calculations on the figures of the City and Southwark Railway, which are of no interest to our readers; but we may quote its concluding remark, which is as follows: "In short, this first attempt at a metropolitan railway merits our attention, the more so as it will be completely worked by electric means, and that it offers a solution as perfect as possible of the complicated question of the transport of passengers to the centre of Paris."



A NEW LIGHTNING GUARD FOR ELECTRIC LIGHTING AND POWER INSTALLATIONS.



MORRISON'S ELECTRIC CARRIAGE.

Additional Facts Concerning Major Bessolo's Early Electric Railway, with an Overhead Conductor.*

BY A. M. TANNER.

In a former article I set forth the claims of Major Alexander Bessolo (now of Turin, Italy) as having first proposed an electric railway system in which an overhead conductor and the rails served as a circuit, and a rotary electric motor on a car was included in a traveling connection between said overhead conductor and the rails. In said article I considered certain patents granted to Bessolo in France and elsewhere, and stated that while the patents did not illustrate or specifically mention a traveling connection between the overhead conductor and the car motor, there was no reason to believe that Bessolo did not have such a traveling connection in view. It was during the same year, viz., 1855, that the Chevalier Bonelli, inspector of telegraphs of the Sardinian States, invented his so-called locomotive telegraph system, and worked it practically between Paris and St. Cloud. A French patent for said system was granted to Bonelli on Jan. 9, 1855. It shows what is now known as "the third rail conductor," for conveying an electric current to a translating device upon the car through the medium of a contact device sliding upon said third rail conductor. In this system of Bonelli, as well as in others devised about the sametime by De Castro, Guyard, Du Moncel, and others, for establishing a telegraph communication between a train and the stations, it was proposed to use a conductor insulated from the ground, and the rails as the circuit, and obviously in all these systems the translating device was in derivation between the insulated conductor and the rails. Consequently when Bessolo stated that he proposed to use an overhead wire and rails of a railway track as the circuit of a stationary generator of electricity, he obviously had the intention of completing the circuit through a traveling connection between the overhead conductor and the rails. This naturally placed the electric motor on the car in a branch or "leak" between the overhead conductor and the rails, just as is the case in all electric railways of the overhead conductor and trolley type. Everything concerning the genesis of an important invention is always of interest, and hence the writer has carefully investigated sources of information not accessible when his original article was written. It appears that an Austrian patent was granted to Bessolo on the 3d day of December, 1855, and that the specification of this patent is in the Italian language, and Bessolo is mentioned at this time as Lieutenant in the artillery of the Sardinian States. The original specification is in all essential particulars like that of the French patent, but a supplemental specification filed late in the same year, viz., 1855, recites many uses of his electric motor, such as the operation of rotary fans and screw propellers, and the propulsion of vehicles on ordinary roads and railways. In reference to the propulsionof cars on railways, he again states (as in the French patent) that the current is conveyed to the locomotive motor machine by means of the rails and by a conductor insulated from the ground and suspended in a manner analogous to telegraph wires.

Then follows this statement: "Furthermore, such a system of locomotion unites many advantages, because the current can conveniently reach independent vehicles or those united in small trains; also, encounters or collisions on the same track are rendered impossible, because the same current will never allow two trains to be present in the same section of a common conductor; besides, the generators are so located that they can be controlled from the stations."

In order to be considered an impartial chronicler of facts, the writer would say that the Austrian patent of Bessolo does not refer to the utilization of natural forces for driving magneto-electric machines and the transmission of the generated currents to distant motors, as is the case in a certificate of addition of Bessolo's French patent. In fact, the Austrian patent did not contemplate anything more than the use of galvanic batteries for supplying an electric current to a car or vehicle motor, because the description nowhere states that a magneto-electric generator was intended to be used as the source of electricity. In a statement concerning the use of the motor for propelling vehicles on ordinary roads, it is stated that "the battery is only in action while the motor is working." The substitution of one form of electric generator for another in connection with an electric railway circuit formed in part of an overhead conductor and the track

* From the *Electrical Review* (London.)

rails could certainly never arise to the dignity of invention, and hence Alexander Bessolo must be considered as having in reality proposed and described the fundamental features of the modern overhead conductor electric railway system as early as 1855. That Bessolo did not build an electric railway, according to the system described by him, was not his fault. He was ahead of the times, and it needed the advent of the Gramme and analogous machines to bring the modern electrical railway into practical existence. Engineering skill required to perfect partly developed ideas should be duly recognized; but the leviathans of modern electricity should not attempt to monopolize and control what was brought to light by intellectual workers in the field of science many years before this age of electricity.

The Columbia Motor.

In the accompanying illustration, Fig. 1, is shown the large stationary motor of the Columbia Electric Company,

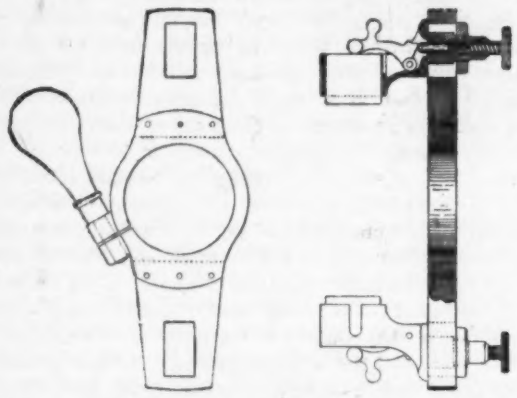


FIG. 2.—COLUMBIA MOTOR BRUSH HOLDER.

of St. Paul, Minn. As will be seen, it is of the two-pole type, the magnetic circuit being of the U form. The commutator is of large diameter, and the brushes are of carbon. The bearings are supported by heavy castings bolted to the base frame in such a way as to give a very rigid construction; self-oiling bearings are used on all sizes of the Columbia Company's machines.

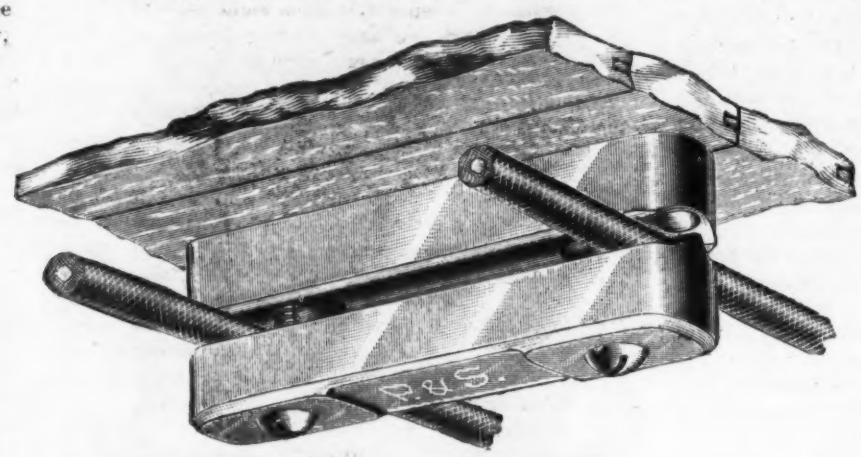
Fig. 2 shows the construction of the carbon brush holder, and inspection of the figure will give an idea of the method employed for securing the necessary tension upon the brush. These machines are said to be practically noiseless, automatic in their regulation, and to require comparatively very few repairs. Power dynamos and generators are built of the same type and sizes, ranging from 25 to 100 h. p. Motors are manufactured of from one to 50 h. p. capacity.

Improved System of Belting.

That electricians and engineers are not yet satisfied with present arrangements for connecting the engines and dynamos is evident from the many devices which have been patented for the purpose of securing better and more economical practice. One of these devices is that known as the "L. P. & D." system o f driving dynamos, manufactured by Perry & Demeritt, Montpelier, Vt., a view of which is given herewith. This system carries the weight of the driving pulley and shaft when in operation in the belt, as in a cradle, and relieves the main bearing of all dead weight. It is also claimed for this method that it gives greater belt contact on the dynamo pulley, and hence greater driving power with less strain on the bearing. It starts the dynamo when the shafting is at full speed, without shock or jar, and releases it with equal ease. It drives the dynamo with the belt as long or as short as the station demands, securing the advantage of great economy of space, and giving elasticity to the belt, while at the same time it enables the operator, as is evident, to have perfect control of the dynamo independently of all others in the station.

A Porcelain Cleat.

The accompanying illustration shows a type of porcelain cleat intended as a substitute for the wooden cleats ordinarily used in ceiling and wall wiring. It is manufactured by Pass & Seymour, of Syracuse, N. Y. It is so made that the wire may be held in position loosely until properly adjusted, when, by tightening the screw, the wire is bent in the rounded jaws of the cleat and held very firmly. This insulator holds any size wire, from the smallest used to No. 6.



PORCELAIN CEILING CLEAT.

Electrical Affairs in St. John, N. B.

A special meeting of the stockholders of the New Brunswick Electric Company was recently called by the officers, to take into consideration the question of transferring the property and rights of the company and the consolidation or amalgamation with another company. The electric lighting business at present is greatly cut up, and all seem to agree that the city cannot support three companies. The New Brunswick Company was considered to have fairly good prospects, for, beside a share of the incandescent business, it has a contract with the city of lighting the streets, in which there is said to be money. But the expenses connected with the building of the station and the purchase of the plant have been very heavy. Then the concern suffered some unexpected losses and a doubling of the stock on behalf of many of the members was necessitated. Negotiations for transfer of the business to another company have been making for some time. Only last week Messrs. G. W. Jones and Joseph Merritt went to Boston and there had a conference with Messrs. John F. Zebley and Charles D. Jones, of the Eastern Company, with reference to amalgamation. It is understood that the agreement reached was that the Eastern Company would assume all the obligations of the New Brunswick and carry on its business, giving the stockholders of the latter preferred stock in the former company. This arrangement is likely to be carried out, as all but one or two of the directors of the New Brunswick Company favor it. Those opposed to the scheme desire amalgamation with the gas company. Some interesting developments in the electric business may be looked for shortly.

The Electrical Specialty Company's New Arc Light Cut-Out.

The cut-out shown in the accompanying illustration is manufactured by the Electrical Specialty Company, of Pawtucket, R. I. The box of the cut-out is made wholly of iron, thus being indestructible, as well as waterproof. This box has been adopted by some of the best known companies as their standard, and it is said that it meets very effectually the requirements of such a cut-out. Its waterproof quality makes it especially adapted for outdoor service for which it has already found quite extensive use.

ARC LIGHT CUT OUT.

Newcastle Assembly Rooms.

The Assembly Room, one of the oldest and most noted buildings in Newcastle, England, opened in 1776, has just been lighted throughout by electric light. The current is derived from the mains of the Newcastle and District Electric Lighting Company, and is carried out from the company's apparatus to main and subsidiary switchboards in the Assembly Rooms. The lighting of the larger ball room is carried out very handsomely with about 200 electric lamps. All the fine old cut-glass fittings have been transformed into electroliers, and this has been done so neatly that not so much as a sign of wire is to be seen, for white silk conducting wires have been used inside the glasswork. It is an interesting item in this installation that these electroliers have served through three great periods of artificial lighting. They were first of service as chandeliers, afterward being altered to act as gasoliers, and now they are used as an elegant setting for the electric light. The general result is most satisfactory, and has called forth the unanimous approval of audiences. A similar mode of installation has been adopted for the small ball room, and the reception rooms have been provided with special fittings for the display of the light. The total equivalent number of 10 c. p. lamps in the building is 440, The installation in the ball

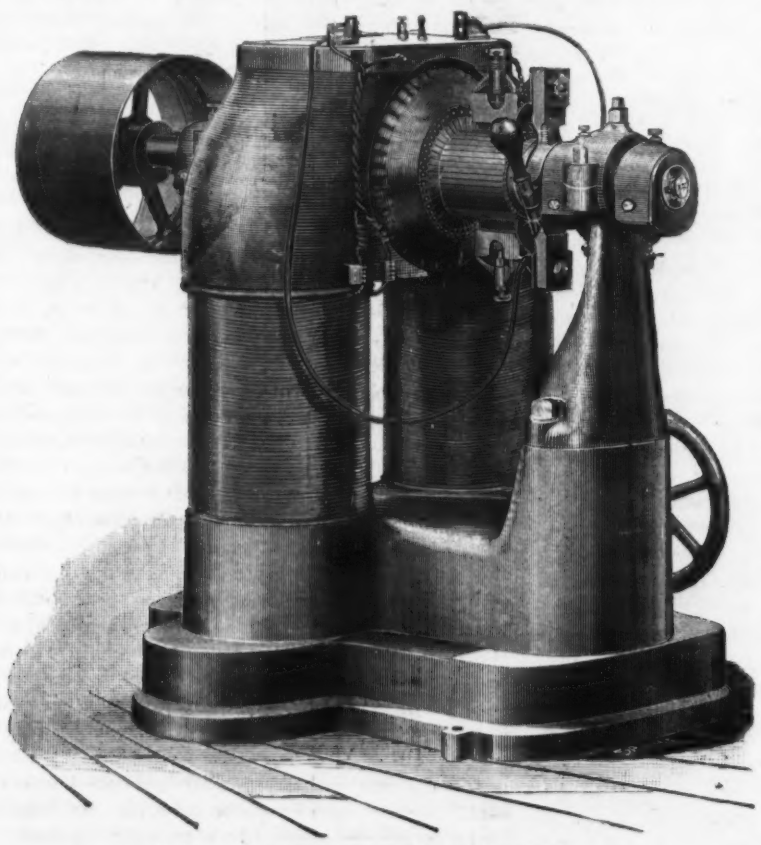
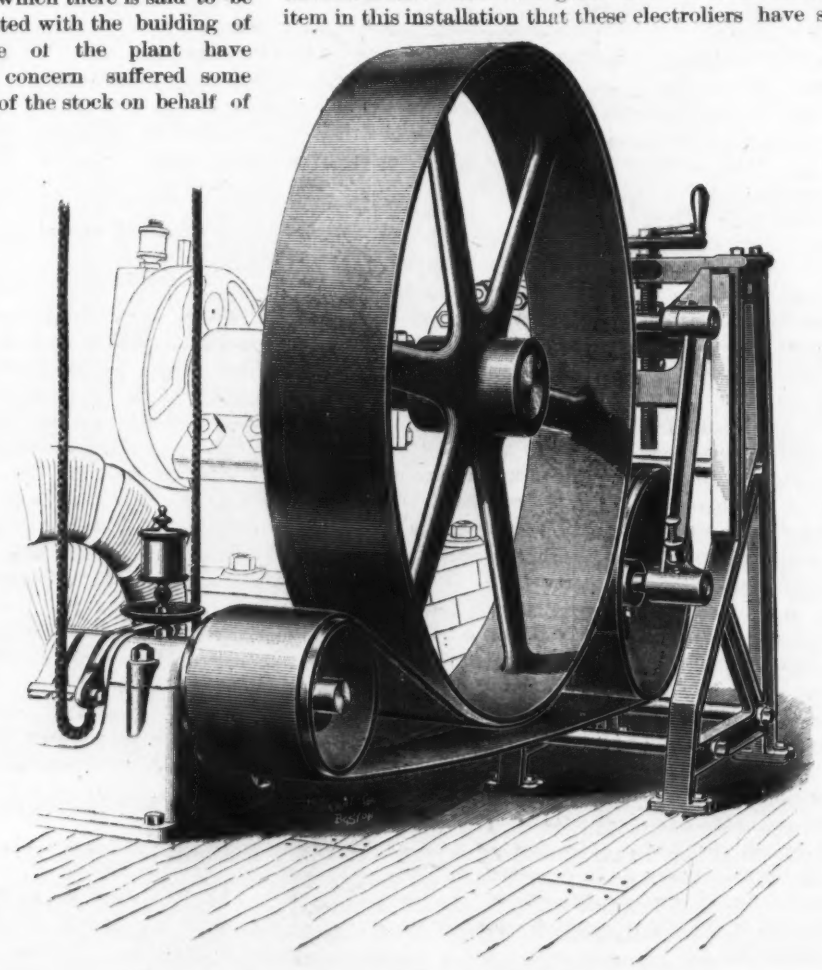


FIG. 1.—LARGE COLUMBIA MOTOR.



"L. P. & D." METHOD OF DYNAMO DRIVING.

rooms was completed within the brief space of 10 days. Messrs. D. Selby Bigge & Co., electrical engineers, Newcastle, carried out the whole of the electric part of the work, and the way in which it has been accomplished reflects great credit on this firm and its staff.

There Was a Bug on the Quad.

It was just before noon on Friday, says a daily contemporary, when the business of the telegraph companies is briskest. The Baltimore quad in the Western Union office had been keeping four operators in New York and four more in Baltimore busy for several hours. There were stock quotations to send and orders to buy and sell to be received. The sending operators were making their fingers dance upon the keys and the receiving operators were racing their pens over the peculiar brown paper which the company furnishes.

Suddenly the instruments began to clatter like the teeth of a man taken with a chill. This told the telegraphers instantly that the finely adjusted piece of mechanism, by the means of which four messages can be sent over the same wire simultaneously, had got out of order.

"She's busted," said one of the men, and he took immediate advantage of the respite to put in a fresh piece of tutti-frutti.

Wire Chief Durivan was called to adjust the instruments. He pottered over them for some time, and concluded that there was a bug on the wire somewhere between New York and Baltimore. The telegrapher's definition of "bug" is "trouble." The instruments were taken off the wire and the wire was tested. It was found to work splendidly. When the instruments were replaced, however, the wire would not work at all. There were no other instruments available, and the connection with Baltimore was completely lost. Messages were piling up on on the table, and the traffic chief, whose business it is to see that there is no delay to dispatches, was almost distracted. Electricians were sent for, and they began a thorough examination of the instruments.

After half an hour's search they found the bug, not on the wire, but on the instruments. It proved to be a Croton bug. It stood on the instrument which regulated the passage of the electric current from the dynamo to the wire in such a way as to connect with its fore and hind legs the positive and the negative currents of the battery which are necessarily separated by insulation. The bug was dead, of course, and the current of 250 volts had fairly glued it to the metal, thereby forming a conductor and temporarily interrupting business between New York and Baltimore for more than half an hour.

The Ticker War on the New York Stock Exchange.

The New York Stock Exchange is determined at all hazards to prevent the Consolidated Stock and Petroleum Exchange, and also the bucket shops all over the country, from obtaining the Stock Exchange quotations, which are a necessary part of the business outfit of all such places.

Unable to prevent the leakage of quotations after months and years of effort, the Exchange has now made an attack upon the Gold and Stock Telegraph Company. The Exchange believes that the Gold and Stock supplies quotations to outside concerns, and the Governing Committee on Saturday last served notice upon the company raising the tariff and surrounding it with more restrictions.

Secretary George W. Ely, of the Stock Exchange, explained the situation as follows:

"For several years prior to May 31, 1887, the Gold and Stock Telegraph Company and the Commercial Telegram Company received the quotations of the Exchange on payment to the Exchange at the rate of $1,500 each per month, and one-half each of the cost of the collection of the quotations, which amounted to a little over $600 each per month. This arrangement was from month to month, to be terminated at the option of either party.

"We ascertained that the Commercial Telegram Company furnished to bucket shops and other parties inimical to the interests of the Exchange our quotations before the time when they appeared on the tape of the tickers. This we protested against vehemently, and endeavored to stop the abuse, but we were unsuccessful. After we failed in this we determined to exclude the Commercial company from the floor of the Exchange. They obtained an injunction restraining us from excluding them. We fought the injunction, and carried the case to the higher courts, the final decision being that we could not turn out the Commercial unless we also turned out the Gold and Stock company; that they were here on equal terms and on the same conditions.

"It came to our knowledge that the two companies were considering the formation of a combination whereby they intended to dictate terms to the Exchange, namely: They were to pay the Exchange only at the rate of $6,000 per annum, instead of $18,000 as heretofore, and to raise the rent of the tickers to members of the Exchange to $20 per month instead of $10. This would have cost the members very nearly $100,000 a year more for rentals of tickers than they had been paying.

"We therefore determined to avail ourselves of the right set forth in the decision—namely, to exclude both companies from the Exchange; and we did exclude them on the 31st of May, 1888.

"In order to prevent confusion and pending further negotiations for providing service for members of the Exchange five days later, on June 5, 1889, we agreed to give the quotations to the Gold and Stock and Commercial Telegraph companies, through the Western Union and Postal Telegraph companies, temporarily only and without prejudice to the existing situation, this arrangement to be from day to day and to be terminable at any time by the Committee of Management of the Stock Exchange without notice. This offer was accepted by both companies.

"Some time thereafter the Commercial Telegram Company got into financial difficulties and was sold out. A new company was formed, called the New York Quotation Company, a majority of the stock of which was purchased by the New York Stock Exchange, in order to provide the service of quotations to members of the Exchange. All the members of the Exchange using a ticker service are now provided, with the exception of six or eight members.

"Since June 5, 1889, we have made repeated efforts to make satisfactory arrangements with the Gold and Stock Company for the service of the quotations on the Exchange to persons who are not members upon terms that are fair and just to the Exchange. Our efforts in that direction have been fruitless. The Gold and Stock Company has, since June 5, 1889, received quotations not only without any charge, but at a cost of about $14,000 per annum to the Exchange.

"The Governing Committee were unwilling to continue this situation. At a meeting held Friday the committee adopted a resolution terminating all existing arrangements with the Gold and Stock Company and the Western Union Company at twelve o'clock Saturday, and instructing the Committee of Arrangements to carry this resolution into effect, which has been done.

"They also adopted an additional resolution in order not to embarass the Gold and Stock Company in disseminating the quotations to firms not members of the Exchange, to the effect that they should permit said telegraph company to receive the quotations through such medium as the Committee of Arrangements should direct, at a charge of $100 per day, payable daily at the close of business; provided, however, that such quotation should be disseminated only to persons not members of the Exchange, and that such arrangements shall be terminable by the Committee of Arrangements without notice. The company has been so notified."

Although the Gold and Stock Telegraph Company had not yet made arrangements to pay $100 a day to the New York Stock Exchange for the privilege of sending the quotations over its lines, all its tickers were running as satisfactorily as usual on Monday of this week, contrary to the expectations of the public.

An action was brought on Saturday afternoon by the Western Union Telegraph Company against W. B. Dickerman, as president of the New York Stock Exchange, and also against the New York Quotation Company, for an injunction restraining these companies from omitting to furnish the quotations.

Judge Bischoff signed the injunction, and also issued an order to show cause why the injunction should not be made permanent.

Government Control of Telegraphs.*

BY ALLEN R. FOOTE.

We are under the impression that a postal telegraph system means an office at each post office. This is the impression given out. We find that is not the case in England, according to the best statistics I can get. In England in 1869 there were 17,829 post offices and 7,021 telegraph offices, being one telegraph office for every 2½ post offices. In the United States for 1891—I believe the statistics are from the *World* Almanac—there are 66,000 post offices and 25,591 telegraph offices, being one telegraph office for every $2\frac{1}{9}$ post offices, so that the percentage of telegraph offices to post-offices in this country is a little greater than it is in England. In England the increase of the number of telegraph offices for two years from 1887 to 1889 was 517. There were 6,514 offices in 1887 and 7,031 in 1889. In the United States the increase for the same time was 3,116, the offices being in 1887 15,876, and in 1889 18,992. The increase for England on 6,514 offices is but eight per cent., while the increase for the United States on 15,876 offices is about 20 per cent. The increase for the United States, 3,116 offices, on that number of offices in England is nearly 48 per cent., against the English increase of but eight per cent.

Mr. Rosewater did say that we had too many wires here and that the country was doing about one-half the business it ought to do. We may look to the explanation of that in this little detailed statement of telegraph offices per population. In England, taking the census of 1881 and adding ten per cent to bring it up to date, there is one office for every 5,500 population. In the United States there is one office for every 2,400 population. I wonder why Mr. Rosewater did not stay in England and get the people to extend the benefits of the telegraph so that the people might be served in equal proportion to the United States.

The size of the country has something to do with the problem—telegraph offices to area. In England there is one office to 17.27 square miles. In the United States there is one office to 131 square miles. The population to the square mile has something to do with it. In England there are 320 to one square mile. In the United States there are 17.93 to one square mile. The area and population to telegraph offices compare as follows:

England—area, 17.27 square miles; population, 5,526.

United States—area, 131 square miles; population, 2,349.

A short time ago it became my duty to make a schedule for correcting the statistics of telegraph companies for the Eleventh Census of the United States. In a circular report which I called for from the companies they wanted to enter commercial news messages, press messages, etc. I said no; what I want is a report that will show what the farmer and the wage workers of this country are paying for the service you are rendering in comparison with what the same class of people pay for the service rendered them by governments that own and operate the telegraph system in foreign countries. For this reason I would admit to the report full rate, night rate and the money transfer messages only and at the rate now being paid over the country by any one who may have occasion to use the telegraph. I have made up the figures on 8,358 full rate messages, 614 night rate messages and 6 money transfer messages. I find that these messages contained 195,914 words, counting all words in the address, body and signature of the message, making an average of 21.82 words per message. The reason for counting the words in this way is that the governments owning and operating a telegraph system count and charge for every word transmitted. The English rate would be 21 cents per message. The tolls paid for these messages in the United States average 41¼ cents. So that on the face of the showing thus far made it would appear that the rate in this country is double that of England. I find, however, that the average mileage of those messages was 540 miles, and the average distance from New York to the places to which they were sent is 603 miles. On account of distance the office in transmitting 8,978 messages repeated over 11,000 messages in the same period of time. As the biggest distance in England is not over 600 miles it is reasonable to assume that the average mileage of 8,978 messages sent out from London will not exceed one half the average mileage of the messages sent out from New York. Therefore messages from New York averaging 540 miles at 41¼ cents each are as cheap as messages from London, averaging one-half the distance, at 21 cents each. This, however, is not the whole story. Messages were sent at the rate given, in any direction desired from New York. England is not large enough to make a comparison with the United States. We are compelled to take Europe for such a purpose. If the citizen of London wishes to send his messages 500 or 600 miles from London, he must go into other countries, as the American citizen goes from State to State. Let this be tried, and then make a comparison of European rates with United States rates.

The rates in New York on 8,978 messages averaging 21.82 words and 540 miles was 41¼ cents. The rate from London for a message of 21.82 words to Sweden is $1.74; United States rate for the same distance 41¼ cents. To Norway $1.52; United States rate for the same distance 41¼ cents. To Germany, $1.30, against 41¼ cents. To Austria, $1.52 against 41¼. To Corsica, 87 cents against 41¼. To Spain, $1.74 against 41¼.

I suppose this is plain why so many people come to this country. It must be to enjoy the privilege of telegraphing a long distance at the low price charged by our grinding monopoly.

I do not know whether Mr. Rosewater can be said to be the representative of the Postmaster General or not; but I do know that we can judge of the kind of advice that the Postmaster General has received on telegraph matters by his official utterances. Here is a government circular dated June 15th, 1891, which says, fixing the rate for government messages, 10 words exclusive of place from, date, address and signature, ten cents to all distances under 400 miles. As the message actually county twenty words, that is ten cents for twenty words for 400 miles. Half a cent a word for additional words. Half a cent for each word in the body. I would like to have Mr. Rosewater state if he believes that a charge of one-half a cent a word will pay the expense of doing the business over a distance of 400 miles. On June 29, 1889, the Postmaster-General issued an order fixing the rate at one mill a word, irrespectively for all messages day and night. If one mill a word for all distances day and night was a fair, honest compensation in 1889, I would like to know what has increased the cost of telegraph service to bring it up to half a cent a word now.

There is one point in a recently published interview with Mr. Rosewater that I want to refer to. Mr. Rosewater can easily set himself right if he is wrongly reported. He says here: "I would buy out all the telegraph lines in America and then advertise for proposals, and have them operated by private companies under the control of the government fixing the rates and requiring them to report their earnings from time to time to the government. When the receipts exceeded ten per cent upon the invested capital, their investment being rather small, I should insist upon their reducing the rate." I suppose he meant dividends instead of receipts. To give an idea of what Mr. Rosewater considers a small capital, he is reported here as saying that the government at the time, that is February 27, 1866, when the government turned over its lines to the private

* Abstract of a discussion on Mr. Rosewater's paper read before the New York Electric Club, Dec. 3, 1891.

companies—the government at that time owned 41,211 miles of land wire and 178 miles of submarine cable.

Mr. Rosewater will probably agree that the true valuation would be the average between his extremes. The statement may be construed to mean that the government owned 14,389 miles of wire worth $2,500,000 or about $174 per mile. At this rate the present valuation of the combined mileage of the Western Union and Postal Telegraph Cable companies is $138,332,834. Now, if the military telegraph lines were worth $174 a mile, it is fair to presume that the lines that are working now commercially are worth as much. On that computation, however, the capitalization of these companies does not begin to reach the values given to it by Mr. Rosewater. That may be where the watered stock is to come in. I am of opinion that if Mr. Rosewater can induce the government so to fix rates that those companies can earn ten per cent. on this valuation that they will give him an exclusive contract to attend to their stock watering hereafter.

Government ownership is advocated by Mr. Rosewater as a principle. In my opinion the principle is radically wrong. It is opposed, as I understand the matter, to the underlying fundamental natural laws that govern all human actions. When you separate a man from any direct interest in his work or any hope of having a direct interest in his work, you separate that man from the most active elements that can induce him to be thrifty, saving, progressive, observing and careful in everything he does. I do not suppose that any of you gentlemen will admit for one moment that there has ever been a work undertaken by government that has been executed at anything like the cost it could have been done for by private parties. A gentleman with whom I was conversing in Boston not long ago—a very competent engineer—observing the work of government buildings, of forts and arsenals, etc., told me that he did not believe that with two or three exceptions in these United States there had been one single instance where a government building had been put up at anything like the cost it could have been put up for by private parties. He estimated that the excessive cost was at least 100 per cent. In other words it cost the government twice as much to do the work as it would private parties. Assuming for the sake of argument that the capitalization of these telegraph companies could be agreed upon—they have accepted a law passed by Congress in 1866 which defines the way in which the government can acquire possession of the telegraph companies—if that were to be carried into operation, the capitalization agreed upon and the interest on the capital figured at the same rate that the government pays on its bonds, the capitalization question would be out of the way. Then comes the question of maintenance and operating expenses. I do not think anyone will suppose for an instant that those expenses, operating under government control in this country, would come anywhere within the limits that they do under private management. I do not think that twenty per cent. difference would be any too large a margin to allow for that. Therefore I assume that the telegraphs of this country, operated under private management, doing a business of the same rate that it would cost the government to do the business, could pay at least a ten per cent. dividend, and at the same time be giving the service at what the ordinary politician calls cost, which is what it would cost the government.

The absence of statistics in all these details is one of the weak points in the argument. When we do not have statistics which both sides can agree upon as being true and accurate we cannot follow our argument through its legitimate course. I have under my hands the work of obtaining these statistics from the telegraph companies in the United States. That work will be accomplished in the course of time provided that the government will furnish the funds to do the work. We are now practically at a standstill. Those of you who want the statistics made up in that way will have to assist in getting the appropriation.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

The Closing Quotations of electric stocks on Saturday, Dec. 12, 1891, in New York and Boston were:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
Western Union Telegraph Co	100	$6,200,000	....	81¾
American Telegraph & Cable	100	14,000,000	....	....
Central and South American	100	5,000,000	....	....
Mexican	100	2,000,000	....	....
Commercial Cable Co	100	7,776,000	....	....
Postal Telegraph Cable	100	5,000,000	....	....
Edison General Electric	100	15,000,000	....	93½
Thomson-Houston Electric Co.	25	6,000,000	48¼	49
" " preferred..	25	4,000,000	26½	26¾
" International Electric Co	100	1,000,000	175	200
Thomson Electric Welding Co.	100	1,000,000	40	65
" European Electric Welding Co	100	1,500,000	18	25
Westinghouse Electric Co., assented	50	7,000,000	12½	13
Fort Wayne Electric Co	25	4,000,000	12	12½

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on electrical stocks as follows:

TELEPHONE STOCKS.

Central Union	$52@	$53	Cumberland	$60@	$62
Michigan	81@	83	Wisconsin	118@	120
Chicago	221@	223	Bell of Missouri	175@	180
Great Southern	30@	32	Iowa Union	20@	22
Colorado	34@	36	Missouri and Kansas	54@	56
Rocky Mountain Bell.	40@	43			

ELECTRICAL STOCKS.

Chicago Arc Light and Power	$83@	$85	Chicago Edison Co	$139@	$140

NEW INCORPORATIONS.

The Marshall Electric Company, of Marshall, Ill., capital stock $20,000, has been formed. The incorporators are Emma Ewalt, Annie J. Travis and C. C. Travis.

The Ballard Electric Company, of Washington, has been incorporated, with a capital stock of $25,000, by D. H. McMullen, G. M. Armour and Thomas Winsor.

The Crowdus Chemical Electric Company, of Chicago, Ill., with a capital stock of $2,000,000, has been incorporated by W. S. Baker, W. A. Crowdus and Charles H. Cooley.

The Hinsdale Electric Light Company, of Hinsdale, Ill., has been incorporated with a capital stock of $12,000. Horace Jackson, Geo. B. Rollins and Geo. M. Bogue are interested therein.

The Philipsburg Granite Electric Light Company, of Philipsburg, Mont., has been incorporated to generate, furnish and sell electric light and all kinds of power, etc. Geo. P. Durham, Jno. R. Cox and Jno M. Evans are the organizers.

The Home Electric Company, of New Brighton, Beaver County, Pa., with a capital stock of $10,000, has been incorporated to supply heat, light and power. L. Roggin Strobridge, Jos. E. Mitchell and N. N. Davidson are those interested.

The Southern Improvement Company, of Dallas, Tex., with a capital stock of $60,000, has been incorporated to supply electric light, heat and power. J. H. Bennett, W. J. Williams, C. J. Baldwin and O. J. Gorman, all of Dallas, are those interested.

The Ottumwa Electric Railway Company, of Ottumwa, Ia., capital stock $500,000, has been formed to create street railway lines in Ottumwa. W. R. Daum, J. B. Sax, Geo. P. Daum, Chas. F. Blake, L. B. Doud and Calvin Manning, all of Ottumwa, are the organizers.

The Owatonna Electric Company, of Owatonna, Minn., capital stock $25,000, has been formed to construct and operate electric light and power plants. H. H. Byllesby, G. G. Dieffie, W. P. Johnson, B. F. Meek, Jr., and H. C. Levis, all of St. Paul, Mich., are the organizers.

Jonesboro & Marion Electric Street Railroad Company, of Jonesboro, Grant County, Ind., capital stock $10,000, has been formed to construct, operate and maintain a street railroad from Jonesboro to Marion. The organizers are Frank E. Snow, W. E. Avery and Charles A. Jay.

The Atlas Electrical Manufacturing Company, of Chicago, Ill., with a capital stock of $12,000, has been incorporated to manufacture and sell dynamos, motor switches, electric batteries, and other electrical appliances. W. F. Matteson, Q. A. Stephenson and J. B. Albertson are the organizers.

The Franklin-Morse Electrical and Mechanical Manufacturing Company, of East St. Louis, Mo., has been incorporated, with a capital stock of $5,000,000, to manufacture all kinds of mechanical and electrical devices and appliances. The organizers are Wm. Keodding, Freeman A. Durgin and William Halleck Jones.

The Fresno Electric Railway Company, of Fresno, Cal., capital stock $1,000,000, has been started to deal in electrical appliances and patents, and to operate street railways in Fresno. Marcus Pollasky, J. R. White, F. J. Berry, Benj. R. Woodworth, W. F. Chandler, Lewis Leach and Morris Messinger, all of Fresno, are the organizers.

The Crocker-Wheeler Electric Company, of Jersey City, N. J., with a capital stock of $200,000, has been incorporated to make and sell motors, machinery and appliances for generating, reducing and employing electricity for light, heat and power. F. M. Jeffrey, W. H. Geers, G. S. Dunn, H. H. Crocker and A. K. Sloan are the promoters.

The Hudson Land Company, of Spokane, Wash., capital stock $50,000, has been started to construct and operate gas and electric light plants, etc. Theo. Reed, A. McKenzie, E. M. Cheadle, Fred. Flint, C. B. Bunning, H. M. Casey and Chas. Jasper, all of Spokane, and P. W. Lawrence and J. H. McCabe are the incoporators.

The Electric Heat Alarm Company, of Bangor, Me., capital stock $25,000, has been organized to manufacture a device which, attached to machinery, gives prompt notice of the over heating of any bearing, and which can also be used to indicate extremely high temperature in rooms. E. M. Hersey and F. S. Palmer are interested in this company.

Yuma Water and Manufacturing Company, of Los Angeles, Cal., capital stock $50,000, has been formed to acquire rights, building and maintaining water-works, in Yuma, and developing and distributing electricity and making artificial ice, etc. The incorporators are A. A. Dougherty, John P. Culver, J. R. Taberman, Walter Rose and Frank H. Jackson.

The Electric Railway Development Company, of San Francisco, Cal., capital stock $500,000, to acquire and dispose of patent rights and inventions for building electric railways, etc., has been incorporated. Dr. DeWitt Clinton Moore, of Oakland, and Geo. F. Dunlap, J. W. Dunlap, Wm. M. FitzMaurice and Ira V. Hitchcock, of San Francisco, are the organizers.

San Diego Electric Railway Company, of San Diego, Cal., capital stock $250,000, has been organized to construct and operate a street railroad to purchase rights and franchises owned by the San Diego Car Company. J. A. Spreckles, A. B. Spreckles, both of San Francisco, Cal.; E. S. Babcock and Charles F. Hinde, of Coronado, Cal., and Jos. A. Flint, of San Diego, Cal., are the incorporators.

The Port Richmond & Prohibition Park Electric Railroad Company has been formed, with a capital stock of $50,000, for the purpose of constructing a street surface railroad, about two miles long, from Port Richmond to Prohibition Park, S. I. Among those interested are W. J. Demorest, Wm. T. Wardwell and Jos. H. Rogerdus, of N. Y. City; B. F. Funk, C. L. Haskell and E. D. Clark, of New Brighton; I. K. Funk and Alex. S. Bacon, of Brooklyn. I. K. Funk and E. D. Clark each take 493 shares of the capital stock.

AFFAIRS OF THE COMPANIES.

The Bell Telephone Company has declared a quarterly dividend of $3 per share, payable Jan. 15.

The Northwest Thomson-Houston Company will pay its first dividend of 2 per cent. on preferred stock Dec. 15.

Columbus, O.—It is reported that there is in contemplation a plan to connect Columbus and Lancaster, O., with an electric railway.

The Eastern Electric Cable Company has declared a regular semi annual dividend of 3 per cent. on its preferred stock, payable Dec 21.

Manheim, Pa.—At a recent meeting of the Manheim Electric Company the following officers were elected: President, Daniel W. Erb; secretary, J. B. Stroh; treasurer, David L. Hamaker.

The Florida Electric Light and Power Company, of Titusville, Fla., has been formed, with a capital stock of $1,000. D. L. Gaulden, Wm. Treutler and J. E. Ender are the incorporators.

The International Trust Company, of Boston, has made application to have a receiver appointed for the Keokuk (Ia.) Electric Street Railway and Power Company, claiming its insolvency.

The Western Union Telegraph Company has declared a dividend of 1¼ per cent., payable Jan. 15. The actual net returns of the company for Sept. 30 quarter were $2,171,154, an increase of $171,154. The net returns for Dec. 31 quarter are estimated at $2,000,000, the same as last year.

The Jenney Electric Light Company, of Fort Wayne, Ind., at its recent annual meeting elected the following officers: President, H. C. Graffe; vice-president and general manager, R. T. McDonald; secretary, A. E. Hoffman; treasurer, C. W. Pixley; directors, H. C. Graffe, R. T. McDonald, A. E. Hoffman, G. W. Pixley, E. Gilmartin, M. W. Simons, J. H. Bass.

The Salem Electric Light, Heat and Power Company, of Salem, N. J., at its recent annual meeting elected the following officers: President and manager, John M. Carpenter; secretary and treasurer, W. W. Miller; directors, Wyatt W. Miller, John M. Carpenter, Robt. Gwynne, Geo. H. Carpenter, Henry Kirk, Thos. Sinnickson, Jr., W. T. Hilliard and I. O. Acton.

Columbus, O.—The stockholders of the Worthington, Clintonville & Columbus Street Railway Company at a recent meeting elected the following officers: O. W. Aldrich, president; F. F. Tuller, vice-president; R. M. Weaver, secretary; H. C. Cooke, treasurer, and O. W. Aldrich, H. T. Chittenden, H. W. Wright, W. F. Griswold and H. C. Cooke, Executive Committee.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, Dec. 14, 1891.

H. Ward Leonard & Co. have secured the contract for wiring the Mail and Express building for 3,500 incandescent lamps, acting as sub-contractors under the Waddell-Entz Electric Company.

New Electrical Society.—An electrical section of the American Institute has recently been organized with the following officers: E. T. Birdsall, president; Dr. L. H. Laudy, vice-president; J. W. Hull, secretary. The section will meet on the second Wednesday of each month at the rooms of the institute, 115 West 38th street. This section will be similar to the polytechnic, photographic and other sections of the institute.

Bids for Lighting the City.—The commissioners on lighting received the following bids for electric lighting for New York for next year: There were six bids, as follows—Brush Company, 151 lights at 40 cents per night, and 114 lights at 45 cents per night; United States Company, 235 lights at 40 cents, 66 lights at 45 cents; East River Company, 247 lights at 40 cents, 16 lights at 60 cents; Mount Morris Company, 154 lights at 40 cents; Harlem Company, 161 lights at 40 cents, 15 at 45 cents, and 19 at 50 cents; North New York Company, 246 lights at 45 cents. The figures are about the same as last year, and were referred to the secretary for tabulation and report.

Mr. John A. Cross, consulting, mechanical and electrical engineer, has recently opened an office at room 216 in the Electrical Exchange Building, 135 Liberty street. Mr. Cross has had an extensive practical experience, extending over six years, in the designing and constructing of engines, dynamos and electric lighting apparatus. He will make a specialty of designing and constructing central stations and isolated electric lighting plants, wiring plans for any system, and will give expert advice and assistance in case of any trouble arising in such systems. He is prepared to furnish estimates, at any time, of the cost of installation of plants, and to draw up specifications.

Mr. Charles E. Chapin has withdrawn from the firm of Alexander, Barney & Chapin, and has entered business for himself, having opened a general purchasing agency, with offices at rooms 417 and 418, Electrical Exchange Building. Mr. Chapin in his new departure offers his services as a buyer to a limited number of supply houses and central stations. Mr. Chapin first appeared in the electric lighting field some six years since, and during that time has occupied positions of responsibility and trust, and has gained a reputation for honesty and reliability. Some three years ago he was appointed purchasing agent for the Sawyer-Man Electric Company, a position which he held for over two years, until the formation of the firm of Alexander, Barney & Chapin. He is well known in the electric field, and on account of his extensive acquaintance and experience in the business is eminently fitted for the new work which he has entered upon. The advantages which will be afforded central station companies, having a resident buyer in New York City, will be readily appreciated.

L. H. H.

PHILADELPHIA NOTES.

Mr. W. R. Watters has joined the staff of The Electrical World and will hereafter have charge of the Philadelphia branch office of this journal.

Branch Office of The Electrical World,
927 Chestnut Street, Philadelphia, Dec. 12, 1891.

Electric Wires in the City Hall.—The Electrical Bureau is laying in excavations made in the asphalt flooring of the second story of the City Hall 17 lead cables, containing altogether 3[illegible] telephone wires for the use of the several departments on that floor, including the offices of the Mayor, Director of Public Safety, and Director of Public Works and their bureaus.

The Philadelphia Traction Company has made application for licenses for one hundred coaches to run on Broad street and Girard avenue. Director of Public Works Windrim postponed action on the matter until he shall have been guided by the opinion of the City Solicitor concerning the right of his department to issue the license. Should the Traction Company receive the licenses and run its coaches on Broad street, it will seriously interfere with the Omnibus Company's general business along that thoroughfare.

City Lighting Plant.—Director of Public Works Windrim has been quoted as saying that if the electric lighting companies combined to keep up their prices for public lighting, he would be in favor of the city establishing its own electric plant. Although the bids for this work had been opened some time since, no contracts have yet been awarded, for the reason that the bids exceed the appropriation recommended by Council. Mr. Windrim's estimate on the basis paid during the current year would make the cost per light for 1892, $155.12; whereas the bids have advanced the average cost per light to about $160.60, an increase of $5.48 per light, and of $9,431.08 over the appropriation.

W. R. W.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Dec. 12, 1891.

Washington, Me.—It is reported that the Pembroke iron plant is to be converted into a manufactory for electric cars and motors.

The Trustees, Series C, Thomson-Houston Electric Company, will make a division of funds in their hands Dec. 19 by the payment of $1 per share.

The Eastern Electric Cable Company has declared a regular semi-annual dividend of 3 per cent. on its preferred stock, payable Dec. 2.

The Rapid Transit Commission is still at work on the problem of better and quicker transportation of passengers through the most congested portion of the city. A plan has been submitted by President Whitney, of the West End Company, which seems to meet with universal favor. This consists of a tunnel for four tracks from Park Square Station under Boylston and Tremont streets to Scollay square. This would accommodate all the North End, all the South End and Cambridge lines and greatly relieve the surface travel on the streets mentioned and not interfere in any way with existing arrangements. Another plan has been proposed that would necessitate taking a portion of the Common to widen Tremont and Boylston streets to admit of laying extra surface tracks. It is needless to say this meets with opposition from a great many quarters by those who regard the Common as sacred and resent in no uncertain way any attempt to take any part of those grounds for street purposes.

C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Dec. 12, 1891.

Mr. G. M. Robinson, president of the Charter Gas Engine Company, of Sterling, Ill., was in Chicago this week.

Mr. Downes, of the William Brookfield Company, New York, paid his respects to the merchants of Chicago this week.

Mr. Jean Wetmore, the affable representative of Okonite, is talking up the merits of that insulation in Chicago this week.

Mr. John Shanc, an affable, quiet solicitor, well known to magazine advertisers, is contemplating entering the electrical railway field.

Mr. E. L. Babcock, president of the Falls Rivet and Machine Company, Cuyahoga Falls, O., is a welcome visitor in Chicago this week.

Mr. E. S. Perot, vice-president of the National Conduit Manufacturing Company, of New York, dined at the Chicago Electric Club this week.

Mr. Clark Sintz, of Springfield, O., stopped over in Chicago this week en route home from Missouri, where he has been installing some of his gas engines.

Mr. F. Day Voorhees, general sales agent of the Norwich Insulated Wire Company, was in Chicago this week advocating the merits of his insulated wires.

The Standard Electric Company, Chicago, is moving from 207 South Canal street to its handsome new building near the corner of Harrison and Canal streets.

Mr. Thomas H. Dallett, of Philadelphia, was in Chicago this week arranging for the handling of the Billberg motor and the other specialties which T. H. Dallett & Co. are handling.

Mr. P. L. Rose, manager of the Rose Electric Light Supply Company, of St. Louis, has been in Chicago this week purchasing a couple of car loads of second hand dynamos and motors.

Mr. W. J. Pilley, formerly representing the Eastern Electrical Supply Company, has entered the service of the Illinois Electric Material Company as one of its traveling representatives.

Mr. W. J. Greene, vice-president and general manager of the Cedar Rapids (Iowa) Electric Light and Power Company, was in Chicago this week purchasing additional material and apparatus for his station.

Mr. A. B. Cotton, of the Chicago office of the Thomson-Houston Electric Company, has sold an electric power plant of 20 h. p. to Purdue University, Lafayette, Ind., to be used for experimental purposes.

Mr. J. W. Godfrey, the general manager of the New York Insulated Wire Company, came in from Portland, Ore., this week, loaded down with some new stories he had picked up while snowed in on the Northern Pacific.

Julius Andrae, of Milwaukee, has closed a contract with F. Kraus & Co., of that city, for a 250-light Mather compound wound dynamo and the complete installation. During this week Mr. Andrae has also sold three one h. p. motors.

Mr. George E. Dorman, electrician to the Standard Electric Company, has opened an electrical and mechanical engineering office in the Manhattan Building, Chicago, and will give special attention to lighting, heating, power and ventilation.

The Edison General Electrical Company called the heads of its departments and its district managers together at a closed special meeting at the Auditorium on Monday and talked over matters affecting the business policy of the company. The gentlemen left for Schenectady Tuesday morning.

The Electrical Construction Company, of Chicago, with the Akron Electric Manufacturing Company, have secured the contract for the complete electric light plant in the new Lexington Hotel, being built in Chicago. This plant will be one of the largest and most complete plants in the city, and will include 4,000 incandescent lights and a number of arc lights.

Mr. S. J. Block, of 7,037 Dickey street, Chicago, has placed one of his vibrationless street car trucks on car No. 1,022, running on the Chicago City Railway lines. Favorable comment is made on the ease with which it carries passengers over crossings and around curves, and receives the application of the brake, the absence of shocks and jars proving a gratifying surprise.

Mr. Julius Andrae, Milwaukee, Wis., has sold and installed a 50-light incandescent plant complete in the Hoffman-Keefer Office File Works; a 100-light plant complete in the Herman Zoehrlaut Leather Company's tannery, and is wiring the residence of T. A. Chapman for 175 lamps to be supplied with current from the new Edison station. A large number of down-town stores are also being wired for the Edison circuits.

The Chicago Electric Club.—The members will enjoy a frolic on Monday evening, Dec. 14, when the bids tendered to the Town Council of Abs, a wet town near Iowa, will be open and the members will listen to the arguments of electric, steam and supply salesmen. Mr. L. A. Ferguson will also favor the club with some recitations, and Mr. W. H. Harding with vocal and instrumental music. A lunch will then be served. The occasion, it is expected, will be a pleasant one.

Mr. James P. McQuaide, treasurer of the National Conduit Manufacturing Company, of New York, and vice-president Perot, are in Chicago figuring on the subways planned for the south side boulevards. These gentlemen stopped at Detroit, on their way West, and were complimented on the excellent service secured by the Detroit telephone exchange (the Telegraph and Telephone Construction Company) wherever their National conduits were used. Subways having ducts in multiple of from four to twenty-six are now occupied and giving satisfaction in every respect.

The Laclede Gas Light Company, of St. Louis, will double the capacity of its incandescent electric lighting plant, and has ordered of the Pond Engineering Company two 250-h. p. compound condensing Armington & Sims engines, with Blake pumps, and independent condensing apparatus. The Pond Engineering Company will put in the foundations and superintend the installation and starting of the plant. It is expected that one of these engines will be in operation by Jan. 1, 1892, and the other shortly thereafter. The first engine will be belted direct to a 2,500-light alternator. The foundations will be carried to solid rock.

Carl Vogel, managing director of the electrical house of Siemens & Halske, of Berlin, Germany, with Alexander Von Babo, the company's New York representative, are quartered at the Auditorium, and are devoting their time to planning a suitable exhibit at the World's Fair. Herr Vogel has asked Director General Davis what protection will be afforded foreign exhibits against injunction and damage suits that American firms might feel inclined to bring, who had the exclusive right to manufacture, display and sell within the United States certain apparatus which the foreign exhibitor had the right to manufacture and sell in other countries. Take the Edison company, for instance. What is to prevent them from bringing suit to prevent the use of any lamp but that made by the Edison Company? A formal answer will be sent in reply to these questions. Chief Barrett showed the gentlemen over the grounds at Jackson Park and also through the city.

The Chicago Electric Club.—The regular literary meeting of the club was held on Monday evening, Dec. 7, with about thirty members in attendance. The reading of the minutes was dispensed with, and after Mr. Degenhart had offered suitable resolutions concerning the death of Mr. W. G. Halm the members listened to the reading of an interesting paper by Mr. C. C. Haskins on the subject of "Safety Devices," after which four short papers bearing on the same subject, and which had been prepared by Mr. George Cutter, Mr. Charles Wirt, Mr. Forée Bain and Mr. Elmer A. Sperry, were read. General discussion then followed on indorsing the remarks of Mr. Haskins that a fuse block should be so constructed that it would only hold a fuse of a certain capacity and nothing larger; and that only a motor cut-out box having no point at which the arm can be left standing between "full on" and "full off" should be allowed on the circuits. Messrs. Dorman, Nichols, L. A. Ferguson, Scheible, Pratt and others participated in the discussion and then Mr. E. C. Ferguson paid a compliment to the writers of the various papers and moved that a vote of thanks be tendered to each. President B. E. Sunny presided and promised that hereafter the meetings would commence regularly at 8 P. M.

The Electrical Department of the World's Fair announces that it already has application for more space than is in the building. There are 200,000 square feet for exhibits. German and English commissioners have asked for 20,000 square feet each; France will use, at least, 20,000 feet. The Bell Telephone Company is preparing to make an extensive exhibit of telephone instruments, including every worthy device out up to 1893. This exhibit will be valued at above $50,000, and will be part of the exhibit prepared by the Western Electric Company, of Chicago. Among the other Chicago firms which have applied for space are the following: Bain Electrical Manufacturing Company, Electrical Merchandise Company, Electrical Supply Company; Prof. Elisha Gray, who will make a fine showing of the results of his researches in electrical science; Alfred Guillaume, J. Lang & Co., Alex. Revell & Co., Sperry Electric Mining Machinery Company, Western Electric Company, and the electrical papers. Among the foreign concerns, Siemens & Halske will use 40,000 feet of space. The English firm of Siemens Brothers will expend about $100,000 on an exhibit, and will use all of the space which they can get—from 25,000 feet down. Of the American companies the Edison, Thomson-Houston and other large companies will be afforded sufficient space to enable them to make an unequaled exhibit. The best from the great mass of exhibits offered will be selected and allotted space from now on.

F. DE L.

SOUTHERN NOTES.

NORFOLK, Va., Dec. 12, 1891.

Paragould, Ark.—An electric light plant, it is reported, will be erected.

Donaldson, La.—The Donaldson Ice Company will add an electric light plant.

Fernandina, Fla.—The Fernandina Electric Light and Power Company contemplates enlarging its plant.

Dickson, Tenn.—An electric light plant will be established by G. W. Belknap, of Nashville, Tenn., and others.

Gadsden, Ala.—The dummy line of the Gadsden & Attalla Union Railway Company will be changed into an electrical system.

Petersburg, Va.—Arrangements have been made by the Petersburg Street Railway Company to change its lines to an electrical system.

Anniston, Ala.—Surveys and estimates are now being made, in consideration of changing the Anniston Street Railway Company's lines to electricity.

New Berne, N. C.—A franchise to build a telephone system was granted to Messrs. O. H. Guion and W. W. Clarke, they to file a bond of $300 to commence work in 30 days.

Galveston, Tex.—Work on the construction of the South Galveston and Gulf Shore electrical railroads will be commenced by the South Texas Construction Company, and the work rapidly pushed.

Ashland, Ky.—The capital stock of the Ashland Electric Light and Power Company has been increased from $25,000 to $100,000. The company will also put in new motors to furnish power to manufactories.

Victoria, Tex.—The Victoria Light, Power and Ice Plant has been leased to W. T. Gaines, who will enlarge and improve the factory, double the capacity of the electric light plant, and put all into operation.

Austin, Tex.—An electrical railroad will be built to the Sanitarium to be erected near Austin, by the National Travelers' Protective Association. C. M. Rogers, J. J. Tobin, H. A. and G. G. Fitzhugh and Nelson Davis have contracted to build the road.

Rome, Ga.—The electric light plant has been improved by the addition of a new 150-h. p. engine, two new 100-h. p. boilers and a 50-light dynamo. The old engine is being repaired also, and new belts and other improvements put in. The capacity of the plant will be doubled.

Richmond, Va.—The Richmond Railway and Electric Company have petitioned to extend their lines and to use the T rails along their loop of track on Church Hill. The company was given permission to use the T rails for four squares, on Broad street, simply as an experiment.

Washington, D. C.—The Hanson Battery, Light and Power Company has been incorporated, with Walter Hanson, Luke Strider and Frank Aldrich as incorporators. The capital stock is $1,500,000, and the purpose of the company is to produce and furnish electricity for light and power.

Salem, Va.—A speedy message was recently sent from here to one of the Channel Islands between England and France. Mr. F. C. Morgan, a resident, at 12:05 P. M. sent a cablegram to a friend in Hauteville, Island of Guernsey, and at 4 P. M. the same day an answer was received.

Lynchburg, Va.—A suit has been entered in the United States Court by the Edison General Electric Company, of New York, against the Charlottesville and University of Virginia Electric Light and Gas Company for $5,000. The action is in assumpsit. The declaration has not yet been filed.

Catonsville, Md.—An electric light and power company will be organized in a few days for the purpose of lighting Catonsville with electricity and furnishing power to electric railways. Mr. William J. Dickey will be the president. Messrs. John Hubner, Joseph M. Cone and other prominent residents are interested in the company. The electric plant will be operated by water power from the Patapsco River.

Macon, Ga.—C. E. McCluer, superintendent of the Southern Bell Telephone Company, of Richmond, Va., and R. B. Hood, manager of the Richmond Telephone Exchange, in company with Manager Gentry and Prof Watton, of Atlanta, have been in Macon examing the new multiple switchboard just put up. The old switchboard could accommodate only 500 wires and four operators with 460 subscribers. The new multiple switchboard has a capacity of 1,500 wires and 10 operators. There are now eight operators employed in the Macon office. The new board is the upright Law system. It is designed to accommodate as many operators as it takes to handle the service. The board was designed in the executive office in New York.

V. N. B.

CANADIAN NOTES.

OTTAWA, Dec. 5, 1891.

Moncton, N. B.—Moncton is to have a new electric light company. Toronto people are at present negotiating about the plant.

Victoria, B. C.—The new Brill car for the Tramway Company which is to run on the Spring Ridge, Pandora street and Beacon Hill Park extension is in every way a success. It is on radia trucks and has two 20-h. p. motors. Another car is expected soon and still another has been ordered.

Ottawa.—Three of the leading iron working establishment whose business has principally to do with steam and its operation have discarded their steam engines and are now running their machinery by electric power. Electric motors supplied by Messrs Ahearn & Soper have been just put in at Messrs. Bannermann & Powers, P. Lour's and J. Low's.

Montreal.—Mr. Robert Bickerdike is visiting Boston to inspect the trolley system of electric cars. It is proposed to use this system in the line from Bonaventure station to Ste. Cunegond and St. Henri. The new proposed road will need about 20 cars in all, and of those eight will need to have motors by the trolley system. Any number of ordinary cars can be attached to a motor car so that the line could run an entire train at a good rate of speed.

Ottawa, Can.—One of the most important cases before the Supreme Court of Canada recently was the judgment in the case of the Great Northwestern Telegraph Company vs. the Montreal Telegraph Company, arising out of the leasing of the latter company's lines to the former company in 1881. The Great Northwestern Telegraph Company claimed to have suffered serious loss, viz., $80,00 per annum, by reason of the competition from the Canadian Pacific Telegraph Company over railway lines which it claimed it was the duty of the Montreal Telegraph Company to prevent, as the C. P. R. Telegraph Company was trespassing on exclusively Montrea Telegraph Company territory. The original rental, $160,000 a year represented 8 per cent. per annum on $2,000,000 capital stock. During the pendency of this suit only 6 per cent. dividend was paid quarterly to the respondents, the balance being placed in the Canadian Bank of Commerce to abide the final judgment in this case. That final judgment, so far as Canada is concerned, was pronounced in favor of the Montreal Telegraph Company, the appeal of the Great Northwestern being dismissed. The judgment of the Montreal Court of Queen's Bench is therefore sustained.

Halifax, N. S.—Mr. Geo. G. Ward, vice-president and general manager of the Commercial Cable Company, has just returned from a visit to London. Mr. Ward says that the company frequently works between Vancouver, B. C., and London with one repetition at Canso, and sometimes this is done between San Francisco and London—unparalleled feats in land and ocean telegraphy. The Commercial service between New York and London is far better than the service between New York and Brooklyn. As evidence of this Mr. Ward mentioned that two brokers, one in New York and the other in London, frequently exchanged from 150 to 200 cables within the hours that business is done on the Stock Exchange. To deliver a message in London within one and a half minutes of the time it is filed in New York is as quick as any one would desire. The system had reached the state of perfection that it is hard to improve on. Nevertheless he is always on the alert for new ideas and inventions, and any improvements that would give another word a minute would be utilized. A new invention, know as the automatic transmission, is being used in the Commercial, which increases the speed and enables the cables to be operated more accurately. The latest experiments were very successful. Mr. Ward says the public realize the fact that had it not been for the Commercial Cable rates would have been double to-day, and the public are appreciating this. Regarding the future Mr. Ward says the friends of the Commercial Cable and Canadian Pacific telegraphs now controlled the Bermuda cable, and active steps were being taken for its extension to Jamaica and other West India Islands. This he regarded as a matter of great importance to the trade of Canada and of political importance to the empire. Matters in regard to the projected Pacific cable were in *statu quo*.

ENGLISH NOTES.

LONDON, Dec. 2, 1891.

City Lighting.—At the last meeting of the City Commissioners of Sewers, the petition of the City of London Electric Lighting Company for an extension of time in their street lighting contract was peremptorily refused. Considerable indignation was expressed at the dilatory methods of the company.

The Telephone Companies.—Both the National Telephone Company and its potential rival, the New Telephone Company, are applying to Parliament this session for bills authorizing them to run wires over and under the streets and generally to do as they please "for the full and efficient performance and maintenance of telephonic communication" in the metropolis.

The Electric Lighting of Saint Pancras.—The enterprising Vestry of St. Pancras, whose central station is now almost ready to come into operation, has just been left in a somewhat unpleasant financial fix. It applied to the London County Council for a loan of £60,000 to be repaid at the end of 42 years, and has been met with a refusal, as the County Council has scruples in lending money on such perishable commodities as dynamos for so long a period. The Vestry has now promoted a private bill with a view of obtaining Parliamentary permission to raise a loan for electric lighting. The raising of money by local authorities for electric lighting purposes is, therefore, not quite so easy a matter as the advocates of municipal central stations would have us believe.

Science and Conjecture.—The well-known weekly paper, the *Spectator*, recently had a remarkably caustic and witty leading article under the above heading inspired by the speeches of Prof. Crookes at the Institution dinner, in which he gave somewhat too free vent to his imagination. The *Spectator* is of opinion that the scientific authorities of to-day have fallen into a rather provoking and tantalizing habit of taking the public into their confidence and making known to it discoveries that are as yet only half known to themselves and building upon the basis of these discoveries a bewildering fabric of conjectural possibilities as to the extraordinary phenomena that *may* result should these discoveries prove true. The attitude recommended by the *Spectator* as the one to be adopted by the British public is one of prudent open mindedness, neither belief nor disbelief, but merely patient expectancy.

Workshop Measurements.—A paper was recently read by Captain Sankey and Mr. F. V. Andersen at the Institution of Electrical Engineers upon the system adopted for electrical measurements at the works of Messrs. Willans & Robinson, the well known high speed engine makers, of whose firm Captain Sankey is a member. A large number of dynamos of all kinds pass through these shops, and in the majority of cases careful electrical tests are made. Some of these are of the highest importance, as in the case of admiralty and supply station work, and for this purpose Messrs. Willans & Robinson have deemed it advisable to lay down the very best possible apparatus. They have adopted D'Arsonval galvanometers for measuring both volts and ampères, the latter being determined by the fall of volts on a known resistance. There was very little new in the methods, but in the discussion which followed it was shown that great interest was felt in the matter by engineers, and incidentally Mr. Weston's voltmeters came in for very high praise. It is certain that no higher efficiencies have ever been measured than in Messrs. Willans & Robinson's works. The paper met with considerable criticism from professorial quarters, but this only tended to show the difference which exists between laboratory and workshop methods.

Electric Lighting and Traction Notices.—The time for giving official notice in the *London Gazette* of proposed electric lighting and traction schemes expired on Monday evening. With regard to electric lighting orders only 34 are applied for, as against 76 last year and 159 the year before. Of the total number applied for 11 refer to the metropolis and 16 are applications from local authorities. On the other hand, electric traction notices are, as might be expected, more numerous than was the case last year, when only nine were issued, as against 15 this year. I have in previous letters mentioned the various electric lines proposed in the metropolis as they have been announced, but a brief résumé may be of interest. The City & South London Railway proposes a northern extension, which will about double the length of the line. The Central London Railway, which obtained power last session and which has just commenced experimental borings, proposes to add about a quarter of a mile to its line, already some 6½ miles long. Two electric railways are projected from the terminus of the Southwestern Railway Company, which is very inconveniently situated on the south side of the river. One of these lines will run into the city and will, I hear, undoubtedly be carried out. The other will run across the west of London and make connection with the existing Metropolitan Railway at its Baker street station. A much needed line is also projected from Hampstead Heath to the Charing Cross station of the Southeastern Railway. There is also some talk of a line from Epping Forest into the city.

The Alleged Decrease of Hysteresis Losses as the Load on a Transformer Increases.—At a meeting of the Cavendish Physical Society on Tuesday, Prof. Ewing communicated the preliminary results of some interesting experiments, which he has been carrying out with a view of settling once for all the oft debated question as to whether or not the hysteresis losses in a transformer fall off as the load is increased. Prof. Ewing's method, which was recently described in *The Electrician*, is a very neat one. He takes two precisely similar transformers with ring cores of insulated iron wire and winds one so that its coils are magnetically inactive. In each core a thermo-electric junction is imbedded and these are connected in opposition through a galvanometer. The primaries and secondaries of the two transformers are respectively connected in series and an alternating current is passed. The active transformer tends to become hotter than the inactive one, owing to the core losses. These are, however, balanced by heating the core of the inactive transformer by means of a current. On closing the secondary of the active transformer, it will, if the hysteresis loss falls off, be necessary to diminish the current warming up the core of the inactive transformer, in order to keep the galvanometer at zero. Although Prof. Ewing varied the frequency from 100 to 130 periods and the induction from 6,000 to 12,000, interchanged the transformer windings, and, in short, altered the conditons of the experiment as much as possible, *no difference whatever could be detected in the amount of balancing current required to maintain the equilibrium of temperature under different loads.*

The Attitude of Municipalities Toward Electric Light Undertakings.—The Liverpool Electric Supply Company is making an application to the Board of Trade for a new provisional order, and the reasons put forward for this application are a somewhat striking example that the haste in which most municipalities are to buy up electric light undertakings is adverse to the interests of the consumers. The Liverpool company has two orders, one dated 1889, covering the central portion of the city, a second, dated this year, relating to another area. As a condition to their consent to the granting of the first order the Liverpool Town Council insisted upon the insertion of a clause giving them the option of purchase at the end of 21 years, instead of 42 years, as fixed by act of Parliament. In the second order the usual period was allowed. The company charge under a sliding scale with a maximum of one shilling per unit, and they assert, probably not without reason, that having regard to the brief period fixed by their 1889 order, they cannot charge less than the maximum rate, if they are to see any reasonable return for the money invested. To remedy this state of things the company now asks for a single order covering the whole of their district and the insertion of a clause extending the life of their undertaking to 42 years, promising if this is granted to fix their maximum charge at 8d. The Brighton Town Council at a recent meeting refused a recommendation of their Lighting Committee to purchase for £7,000 the good will of the Brighton & Hove Electric Light Company's concern, and decided at the same meeting to borrow £8,500 to enable them to run mains in the company's district. Although legally the Brighton company has no *locus standi* and has all along assumed a not altogether politic attitude with regard to the Town Council, it must be confessed that this decision of the Town Council to make use of its superior position to ruthlessly extinguish a private enterprise, which supplied a large area of Brighton with the electric light at a time when the Town Council itself thought the venture too dangerous, is scarcely an example of English fairmindedness.

News of the Week.

THE TELEGRAPH.

South Aberdeen, Wash.—The Western Union Telegraph Company is to continue its line from this place.

The Postal Telegraph and Cable Company has extended its lines and will open an office at Iowa City, Ia., which will be in charge of Mr. U. T. Lodge.

The Postal Cable Telegraph Company has completed its line from Charleston, S. C., to Savannah. The office in Charleston is in charge of Mr. Moses S. Harris.

The Construction of a Telegraph Cable to the Sandwich Islands is recommended by President Harrison in his message as worthy of promotion by the government of the United States.

New Telegraph Lines.—The linemen for the Southern Massachusetts Telephone Company have just completed a new circuit extending from the Westport factory to Central Village and thence to Fall River. A special wire has also been put in from the Westport factory to New Bedford.

THE TELEPHONE.

The Bell Telephone Company expects to have its telephone line between New York and Chicago finished by the opening of the World's Fair. It will be the greatest long distance line in the world, being nearly 1,000 miles in length.

The American Bell Telephone Company, of Boston, has under construction 50 lines between New York and Chicago. Each line has two wires, and as the distance between the two cities is about 980 miles, the total quantity of wire required for these lines, it is stated, is 98,000 miles, enough to go four times around the globe. These lines are all built with copper wire, weighing 174 pounds to the mile, and 17,052,000 pounds, or 8,526 tons, of wire is required for the undertaking.

The Bell Telephone Case, after two years spent before the government in taking testimony for the United States, it is believed has been completed, although the Circuit Court in the session at Boston has extended until Dec. 24 the time for taking of the evidence It is stated that all the government hopes to do is to bring before the Supreme Court the Drawbaugh case once more with the expectation that the court, which was almost evenly divided on the Drawbaugh suit, may give a different decision this time.

The Hudson River Telephone Company's special committee, consisting of General Manager A. B. Uline, Superintendent William H. Cull and Mayor Manning returned to Albany early in the week from Philadelphia, where they had been studying the workings of the Law telephone system. Their report to the executive committee in New York was unfavorable for that system. Manager Uline sums up the matter by saying: "Electrically and theoretically the system is perfect, but hardly practicable. The difficulty would be in educating the subscribers to the system." Electrical experts are now examining a system that is said to combine the best points of the Law and the standard systems, to supersede the present system in use in Albany. The company's handsome new building is nearing completion; the conduits have been laid and the overhead wire nuisance in Albany will soon be a thing of the past.

THE ELECTRIC LIGHT.

Lacon, Ill., is to have electric lights.

Reed City, O., is to have electric lights.

Oxford, N. Y., is to be lighted by electricity.

Avon, Ill., is to have electric lights at an early date.

Meredith, N. H.—The town is moving for electric lights.

Cadillac, Mich., has just put in a new electric light plant.

St. Ignace, Mich., is to have electric lights in the near future.

Enterprise, Kan.—The town is to have an electric light plant.

Cleborne, La.—The City Council has contracted for 30 arc lights.

Denison, Ia., is likely to have an electric light plant in the near future.

Farmington, Ill., has granted a franchise to an electric light company.

Morgantown, Pa.—A contract has been let for an electric light plant.

Greensboro, N. C.—Bids for electric lighting are open until Feb. 1, 1892.

Rock Rapids, Ia.—The town will have an electric light plant in operation soon.

Cloquet, Minn., is agitating the question of the installation of an electric light plant.

Mt. Pulaski, Ill., has contracted for 19 all-night arc lamps for $84 per light per annum.

St. Clairsville, O.—It is expected that the electric light plant will be in operation soon.

Estherville, Ia., will vote Dec. 20 on the question of granting an electric light franchise.

Aledo, Ill.—It is expected that the electric lights will be in operation by the first of the year.

Little Rock, Ark.—Mr. H. G. Allis has secured from the City Council a franchise for an electric light company.

Fowlerville, Mich.—An electric light plant is in operation, and the city lighting will be done for $750 per year.

Little Falls, N. Y.—The Little Falls Electric Light and Power Company expects to have its plant in operation by Jan. 1.

Chelsea, Mich.—It is reported that Messrs. Strong Bros., of Homer, Mich., will put in an electric light plant at Chelsea.

Argos, Ind., wants an electric light plant, and a committee of business men has been appointed to inquire into the subject.

Detroit, Mich.—It is expected that the plant of the new Citizens' Electric Light Company will be ready for operation soon.

Braidwood, Ill.—The Council had decided to purchase a Thomson-Houston electric light plant for the city at a cost of $6,680.

Morrelton, Ark.—The new electric light plant, which is owned by W. E. DeLong, is in operation, and is giving the best of satisfaction.

Keithsburg, Ill.—A petition is being circulated among the citizens asking the City Council to make provision for an electric light plant.

Denison, Ia.—The question of granting a franchise for the erection of an electric light plant was recently put to vote and carried, 193 to 9.

Anamosa, Ia.—A new electric light plant, costing about $8,000, is expected to be in operation soon. Several improvements are contemplated.

Painesville, O.—A projected electric light plant is receiving considerable discussion. The gas company now proposes to put in an opposition plant.

Moline, Ill.—The Moline Wagon Company, it is stated, has decided to adopt the Brush system of arc lights, and the plant will be installed at once.

Westernport, W. Va.—The citizens recently held an enthusiastic meeting to consider ways and means for providing an electric light plant for the city.

Luverne, Minn.—The Thomson-Houston Electric Company has arranged to put in an electric light plant, which will cost in the neighborhood of $15,000.

Lacon, Ill.—The town will soon have electric lights, the Thomson-Houston Company having accepted a proposition recently made by the Common Council.

Elroy, Wis.—A petition asking for a permit to light the city by electricity was presented to the Council at a recent meeting and referred to a committee.

Walton, N. Y.—The work of putting in an electric light plant is progressing rapidly, and it is expected the plant will be in operation within a short time.

Deadwood, N. Dak.—The electric light plant formerly owned by Arthur McHose has passed into the hands of Thos. Mansfield, who will operate the plant in the future.

Ballard, Wash.—The Ballard Electric Light Company has closed a contract for its plant, and it is stated that it expects to be able to light the town by the first of the year.

Rome, Ga.—Extensive improvements are being made with the Rome electric light plant. The capacity will be doubled and a new 125-h. p. boiler will be added; also a new dynamo.

Madison, Ind.—The Madison Gas Company has formulated a proposition proposing to consolidate the gas and electric light interests of the city, to furnish electric light and power.

Bowling Green, O.—The city electric light plant has been sold by the City Council to E. H. McHight, who will operate it in the future, and who contemplates several improvements.

Cheboygan, Mich.—James F. Maloney and G. E. Fisher have been awarded the contract to supply the city with electric lights. They will put in two 50 arc-light machines and one 1,000-light incandescent.

Ann Arbor, Mich.—At the recent meeting of the board of directors of the Ann Arbor Thomson-Houston Electric Light Company, it was decided to increase the capacity of the plant by adding a 650 alternating dynamo.

Kansas City, Kan.—It is stated that the City Council is to accept the proposition to buy an electric light plant for $300,000. A special election will be called to ratify the action. If the purchase is authorized bonds will be issued for the amount.

Mascoutah, Ill.—It is believed that the electric light plant will be in operation within a few days. The company will furnish the city with 50 street lamps of 32-c. p. each for $1,000 per annum. The company has also contracted to furnish 200 private lights.

The Thomson-Houston Electric Light Company's gross sales for the quarter ending Oct. 31 were $3,098,573, as against $2,785,073 last year. The gross sales for the nine months preceding that date were $7,165,411, against $7,514,520 of the same time a year ago.

Moberly, Mo.—The plant of the new Moberly Gas and Electric Company is nearly completed, and will soon be in operation. The cost of the plant, including machinery and buildings, was $40,000. Thomson-Houston arc light dynamos and Westinghouse incandescents are used. It is run by a 250-h. p. Hamilton-Corliss engine. The plant is said to be one of the most extensive in the country.

THE ELECTRIC RAILWAY.

An Electric Road to cost $600,000 is contemplated from Lowell, Mass., to Haverill, and the Massachusetts Legislature will be called upon to approve it.

Electric Railway Express Service.—The electric railroad company of Amsterdam will soon put into operation a system of express delivery for all sections of the city.

Seattle, Wash.—The Trunk Line has closed a contract with the Northwestern Thomson-Houston Electric Company for a complete new equipment of its electric lines, at a cost of about $60,000.

Detroit, Mich.—The Detroit, Spring Well & Dearborn Railroad Company, with a capital stock of $100,000, is a recent incorporation which proposes to construct a suburban electric street railway from Detroit to Dearborn.

Salem, Mass.—It is understood that the Naumkeag Street Railroad Company has practically purchased the Essex electric road of Salem and Peabody, and that the roads will be continued as nominally separate corporations, but practically as one.

The Westinghouse Electric Company, it is stated, is considering a change in the location of its street railway motor department to a new site on Robinson street in Allegheny. The proposed change is made necessary on account of the demand for more room.

The Electric Locomotive.—The Thomson-Houston Electric Company will shortly begin work on a new electric locomotive for passenger service, which it is expected will develop a speed of 40 miles an hour. It will have 6,000 pounds draw bar pull, will weigh 16 tons, and be of 350 h. p.

The Railroad Committee of the Brooklyn Board of Aldermen, has under advisement the proposed introduction of the trolley system on the surface roads of the city. It is the impression that the system will be approved and that the Mayor will give his endorsement to the action of the committee.

Marlborough, Mass.—It is stated that if the Legislature gives the Marlborough Street Railway Company authority to extend its

line early next season, the capital stock will be increased and a line of electric cars will be running from Marlborough to Westborough by July 1. The line may also be extended to Hudson.

Lynn, Mass.—President A. F. Breed, of the Lynn & Boston Railway Company, says the 70 miles of track in Lynn will be equipped with electrical apparatus within another year. President J. A. Towns, of the Belt Line, says that the project to unite Boston, Lynn, Salem and Newburyport is practical, and may be carried out in the near future.

Albany, N. Y.—The Albany Railway is putting up poles and stringing wires on the Steuben street line. The motors will run on the new line within a few weeks. The South Ferry street line has been completed, though the electrical service will not be extended to Greenbush until the spring. Over five miles of tracking have been laid since May 1 last.

Burlington, Vt.—The Vermont Electric Company has presented a petition to the City Council for consent to construct an electric street railway. If the petition is granted the trolley system will be used and the work will be started at once. The company expects to be ready by Jan. 1 to make contracts for furnishing electric power for all classes of business requiring it.

Electric Elevated Railroad.—F. W. Chapman, a Chicago ex-Alderman, has a plan for rapid transit, which incorporates the system of elevated street railroads, which it is stated has been commended by engineers and capitalists. It provides for a road supported on iron posts placed between the double tracks of the surface roads, with electricity as a motive power. It is estimated that the cost per mile of the system will be $150,000.

The Julien Motor Works Closed.—On complaint of the Brush Electric Company and the Consolidated Electric Storage Company, Judge Edward T. Green, of the United States Circuit Court of the District of New Jersey, has granted a restraining order against the Accumulator Company, whereby it is stated that the works of the latter, in Newark, will remain closed pending a hearing on Jan. 7, when the company must show cause why a permanent injunction against its further operation should not issue.

Electric Railway Statistics.—Mr. J. A. Powers, of the Glens Falls Electric Railroad Company, gives some interesting statistics in round numbers about what the plant has accomplished during the first five months ending Dec. 1. Three hundred and two thousand four hundred passengers have been carried, a daily average of 2,000. The service for each month was as follows: July, 54,000; August, 67,270; September, 87,500; October, 50,000; November, 43,400. The first motor cars were started the middle of last June.

Financial Backing for the Portelectric System.—Our readers are already familiar with the portelectric system of high speed transmission of mail and express matter, a thorough test of which has been in progress for over a year in one of the suburbs of Boston. The system is now to be tried on a much larger scale, and will be given a test in actual commercial service. A company known as the United States Portelectric Company has been organized, with a capital stock of $5,000,000, for the purpose of exploiting the system. Among the names of the incorporators are a number already well known in financial circles. The incorporators are as follows: Ex-Postmaster General Thomas L. James; John S. Straiton, of Straiton & Storm; ex-Judge A. J. Dittenhoefer; Chas. F. James, attorney; Percival Knauth, of Knauth, Nachod & Kuhne, bankers; William James, foreign agent N. Y. C. R. R.; John T. Williams; Postmaster Henry Huss, Mt. Vernon, N. Y.; Frank Lawton and Whipple V. Phillips, of Providence, R. I.

LEGAL NOTES.

The Suit for Infringement of patent brought by the American Bell Telephone Company against Samuel H. Kissam, Henry W. Whitney, Eugene R. Washburn and William E. Fowler has been discontinued, the defendants having surrendered to the complainants the infringing instruments.

Delay in Delivery of Telegram.—The United States Circuit Court for the Western District of Arkansas held in the recent case of Cranston vs. the Western Union Telegraph Company, that where the delivery of a telegraphic message has been negligently delayed by the agents of the telegraph company the party receiving the message cannot recover for mental suffering alone when unaccompanied by other injuries, and that in order to warrant the consideration of mental suffering as an element of damages there must be such gross negligence on the part of the agents of the company as to indicate a wanton or malicious purpose in failing to transmit and deliver the message, and the mental suffering must be an element of physical pain, or the natural and proximate result of some physical injury.

Forfeiture of Franchise.—In the case of the People vs. the Los Angeles Electric Railway Company the Supreme Court of California recently handed down a decision in regard to the forfeiture of franchise. The constitution of California provides that no act shall be passed extending the charter of any corporation or remitting the forfeiture of a franchise. Where during the pendency of an action forfeiting the charter of a street car company operating under a city ordinance two acts were passed, one amending the civil code of the State so as to invest municipal corporations with power to authorize street railways to use electricity as a motive power, and the other ratifying existing ordinances granting such power, the Supreme Court of California held that the acts did not extend the company's franchise or charter, and that as there had been no decree of forfeiture there was none to remit, and therefore the acts were not repugnant to the constitution.

GENERAL APPLICATION OF POWER.

Transmission of Power for Mining Purposes.—The Flint Creek Electric Power Company was organized last June for the purpose of utilizing the series of falls that exist on Upper Flint Creek for generating electric current to be transmitted a distance of seven miles to Phillipsburg, Mont. In this way sufficient power is obtained for all the mining camps located near Phillipsburg. The incorporators of the company are C. M. Bennett, of Virginia City, and Messrs. Baker & Harper, of Butte, Mont. The capital stock was fixed at $25,000. This sum has been already expended and it is estimated that, when completed, the works will cost $100,000.

EDUCATIONAL NOTES.

DEPARTMENT OF ELECTRICAL ENGINEERING,
SIBLEY COLLEGE, CORNELL UNIVERSITY, Dec. 12, 1891.

The Henry R. Worthington Pump Company, of New York, has presented a very fine sectional duplex pump to the mechanical department. The pump being sectional the student is enabled to study the action of the valves to the best advantage.

The number of students in the University this year is 1,489. There are 250 in the electrical course, this department having the largest percentage of students in the university. Following this is the mechanical course with 241, and the civil engineering with 139.

Nearly Ready for the Engine.—The foundations for the new triple expansion Corliss engine are about completed. The holes in the top stones for the tie-bolts of the engine bed are now being drilled with the Ingersoll rock drill, which belongs to the testing department of the mechanical laboratory.

A World's Fair Engine Designed.—The designs for the new triple expansion engine for exhibition at the World's Fair have been completed. The type of the engine is to be upright, with cylinders 14¾, 8¾ and 6 inches respectively. It is to have riding cut-offs, but to be arranged so that they may be made fixed at any time. The stroke is to be 18 inches, and the engine is to be run at 175 revolutions. The design is such that it may be run either as a simple, compound or triple expansion engine. It is calculated to deliver 90-h. p.

The Johns Hopkins Electric Club is the name of a new scientific society which has been recently formed at the Johns Hopkins University, Baltimore, Md. It is composed of a number of gentlemen who have devoted themselves to special departments of electricity. The officers of the club are: Louis Duncan, president; C. E. Breithaupt, secretary. Executive committee, H. W. Frey, H. S. Hering and J. Hewes. The society will hold its meetings every two weeks, and papers on original work will be presented and read by the members.

PERSONALS.

Mr. N. W. Rolt, formerly local manager of the Edison Company, Winnipeg, Man., has been transferred to the Toronto offices of the company.

Mr. W. H. Mackay, manager of the Roanoke Electric Light and Power Company, of Roanoke, Va., has resigned, and will engage in business for himself in the electrical line.

Mr. W. G. Halm, of the Knapp Electrical Works, died at Washington, D. C., on Dec. 2. Mr. Halm, who was well known in the electrical field, had been unable to do any active work for the last year. He was vice-president of the Perkins Lamp Company at the time that company disposed of its plant.

MISCELLANEOUS NOTES.

Separating Ore by Electricity.—The plant which has been established at Ishpeming, Mich., for the separation of iron ore by electricity is reported to have been very successful. The works have so far turned out 30,000 tons of Bessemer ore.

He Still Lives.—The electricity committee of the World's Fair some time since decided to carve the names of eminent electricians now dead over the entrances of the Electricity Building. Among the names that the committee decided upon was that of Dr. Channing, of Pasadena, Cal. Dr. Channing is still living, and when the eminent electrician saw that his name was to be inscribed as among the dead it is stated that he wrote to a friend modestly suggesting that for the present at least he preferred to be omitted from the list of the distinguished dead, even though his name would be written in marble. His request should be granted.

Industrial and Trade Notes.

The Century Pottery Company, of Camden, is settling into nice business and is now in a position to fill any orders which it might be favored with.

J. Elliott Shaw & Co., of 632 Arch street, Philadelphia, report the sale of their Norway iron frame bells as good. In their general supply trade they still have a very good demand.

The Illinois Electric Material Company, Chicago, have lately secured the western agency for the Redding fire gong, Redding's watchman's clock, and for the Draper oiler.

The Wagner-Queen Voltmeter, manufactured by Queen & Co., Philadelphia, will be found to be durable, compact and accurate. The sale since their introduction has been large and steady.

J. H. Bunnell & Co., the well-known supply house, should be credited with having placed the order for the 1,000,000 feet of Day "Kerite" wire recently ordered by the New York Central Railroad for their tunnel equipment.

The Perfection Oil Purifier Company, 136 Liberty street New York, reports meeting with the best of success with its oil purifier. A large number of orders have recently been received from different parts of the country.

J. W. Parker & Co., 38 South Fourth street, Philadelphia, electric railway engineers and agents for the Ball Engine Company, of Erie, Pa., are figuring on several extensive orders. They report business in their line as being good.

Slate for Electrical Purposes.—The Munson (Me.) Slate Company, Boston, is making a great variety of slate for electrical purposes. In fact it has facilities for turning out anything in that line, and it is said by those that have used it that it is of the finest quality.

Mr. Robert Grimshaw, of 21 Park Row, New York City, is preparing for publication a "Record of Scientific Progress in 1891," and would take it as a favor if those who know of anything especially noteworthy in scientific lines during the past year would send him particulars of such occurrences.

The Cash Safety Car Company, of Lynn, Mass., has been formed for the purpose of applying its system of gates to the regular open street cars. It is claimed that by the use of these gates the number of accidents will be reduced and that fares can be more readily collected than at present.

E. G. Bernard & Co., of Troy, N. Y., have just constructed an incandescent electric lighting plant for Haight & Co.'s leather factory in that city. It consists of a 300-light automatic dynamo, and a 35-h. p. automatic engine. This is the three hundred and seventy third factory that Bernard & Co. have furnished with electric apparatus.

H. Ward Leonard & Co. have received an order from Wm. Sellers & Co., of Philadelphia, for two 40-h. p. motors for use upon traveling cranes. The motors are to be supplied under rigid specifications as to dimensions and performance, but the decision as to the particular make of motors to be used is left with H. Ward Leonard & Co.

The Standard Fiber Ware Company, of Mankato, Minn., utilizes the raw tow raised on the prairies of the Dakotas in manufacturing the cleanly looking utensils that are fast becoming part of the equipment of every office and station. This tow passes through half a dozen processes before being pressed into shape, decorated and packed for shipment.

The Card Electric Motor and Dynamo Company, of Cincinnati, O., capital stock $100,000, has been formed to manufacture and sell electric motors, dynamos, etc., light and power, etc. J. W. Wilshire, Geo. Bullock, Otto W. Jantz, G. N. Stone, C. B. Simrall, Franklin Alter and Stephen R. Burton are the incorporators.

The Electric Appliance Company, of Chicago, reports extensive sales of Paranite wire. Some of the points which contribute to its popularity are its highly polished braid, which, owing to the absence of the seam in the rubber, is perfectly smooth and uniform, the inner cover being specially prepared to avoid the corrosion of the tinned copper conductor.

Will C. Turner, who has opened an office, room C, 120 Broadway, for the sale of stocks and bonds having special bearing on electrical enterprises, is meeting with much success. Mr. Turner has Philadelphia, New York, as well as Eastern and Western capital ready to invest in good electrical securities, and consequently his services are greatly in demand.

The Novelty Electric Company, 50 North Fourth street, Philadelphia, reports a large sale for its pocket wire gauge. By a nice arrangement it will, beside giving the American gauge of the wire, give the current the wire will safely carry in ampères. It also gives the ohms resistance per foot of copper wire, from which the resistance of iron or german silver can be found. It is a very desirable little article for linemen and electricians generally.

Mr. George North, who has been for some years general manager of Woodhouse & Rawson, United Limited, electrical and mechanical engineers of London, England, has resigned his appointment in order to commence business as a consulting engineer, valuer and arbitrator at 90 Queen street, London, E. C. A special feature of Mr. North's business will be the purchase, sale and development of new patents and inventions; and he will also act as London agent for mechanical and electrical specialties.

Motor Regulation.—H. Ward Leonard is licensing various manufacturing and construction concerns under his recently patented system of motor regulation. The basis of the license is a charge of $2.50 per k. w. (roughly, per horse power) in the motor. The royalty is not an annual charge, but is paid once for all in each case. Wm. Sellers & Co. have taken a license under Mr. Leonard's patent on this basis, they agreeing to use the method upon all electric cranes they build in the future, during the life of the patent.

The Pond Engineering Company, through its Chicago office, has closed a contract to replace the 60-h. p. Armington & Sims Engine in the American Express Company's Building, on Monroe street, with an engine of the same make, of 120 h. p. The present engine will be moved to the Express stables on Sebor street to operate the lighting plant in the building. For the past nine years the American Express Company's plant has been operated by an Armington & Sims engine, which has given such good satisfaction, that the present order was secured in spite of unusually sharp competition.

The Toronto Construction and Electrical Supply Company, of Toronto, Can., is the first wholesale electrical supply house in Canada, to canvass the entire Dominion by means of capable traveling representatives. Each one carries several sample trunks filled with samples of the latest and best novelties for electrical uses. At the present time one representative is in British Columbia, another in Halifax, N. S., and four others at various points between the two first mentioned, which are nearly 4,000 miles apart, and as a result of such a progressive policy the business of the company, it is stated, has increased with great rapidity.

The Mather Electric Company, of Manchester, Conn., has recently issued a new catalogue of 21 pages, illustrating and describing the electric motors and power generators manufactured by this company. These motors are of the iron clad type, and are designed to give the highest efficiency consistent with a reasonable first cost. The power generators manufactured by the company are designed for street railway, and other power service, and are wound to give, as nearly as possible, a constant potential on the line, and show a high grade of efficiency, running absolutely without sparking. The manufacturers report meeting with a most encouraging business with their motors and power generators, and that they are giving the best of satisfaction.

The Heisler Electric Light Company, of Philadelphia, reports the following sales: Carroll Electric Light Works, Matteawan, N. Y. (increase), 600 32-c. p. lights capacity; Messrs. Rheubottom & Bond, Union City, Mich. (increase), 200 32-c. p.; Merced Gas and Electric Light Company, Merced, Cal. (increase), 400 32-c. p.; Kingman Water and Light Company, Kingman, Kan. (increase), 200 32-c. p.; Glazier-Strong Oil Stove Company, Chelsea, Mich., 200 32-c. p.; Messrs. Cortright & Sons, Homer, Mich., 160 32-c. p. The municipal plant now being installed by the Heisler Electric Light Company at West Toronto Junction, Ont., is nearing completion, and the lights will be in operation very shortly. The company also reports a large and constantly increasing demand for series lamps for use on arc light circuits.

Gould & Eberhardt, of Newark, N. J., are manufacturing a system of cutting-tools for lathes and planers, on a system which has been developed by Mr. Eberhardt, and which has been in use in the Gould & Eberhardt Company for several years. The firm is now about to put these cutters, and holders for the same, upon the market. The following claims of advantages for these tools are made: Economy in grinding; no forging or tempering; tool supported up close; no objectionable projections; no stock of heavy steel on hand; average cutting rake always given; no adjustment of height necessary; time, labor, money and annoyance saved; variety of cutting shapes; increased speeds and feeds can be obtained; grinding of tools required less frequently; steel will not slip in holder under heavy cuts.

The Weston Electrical Instrument Company, Newark, N. J., has taken a contract to build a 5,000-ampère ammeter for the Wilson Aluminium Company, of Leaksville, N. C. This instrument is to be a very large form of the well known Weston type of ammeter, with some important modifications to meet the peculiar requirements of the case. It will have a scale 14 inches long, which will be divided into 250 parts. Each division will equal 20 ampères and the divisions will be large enough to be easily read to tenths, or two ampères, and with care to 1 ampère. The scale will be laid out by actual calibration to the full current to be measured by the instrument in practical work, namely 5,000 ampères. The appliances of the company for standardizing work are generally known to be excellent. Some idea of the perfection of the Weston Electrical Instrument Company's plant in this respect can be formed when we state that the copper conductors in the laboratory for handling ammeter work weigh about 4 tons and that some of the mains have a sectional area of 5 square inches, and that they are capable of carrying a current of 10,000 ampères without inconvenient heating.

Congdon, Bliss & Daniels, contracting and consulting engineers, have recently opened offices in the Alantic Building, Washington, D. C. This is a new firm which was organized the first of the month, and has the agency for the Heisler system of lighting for the District of Columbia, Virginia, West Virginia, North and South Carolina Kentucky Tennessee, Florida, Alabama and

Georgia. They are also agents for the Quaker City dynamos and motors for Maryland, District of Columbia, Virginia, West Virginia, North and South Carolina. They will do expert work and contracting, and will make a specialty of general electrical work. Mr. Congdon was formerly assistant chief of the supply division of the War Department at Washington. Mr. Bliss was contracting agent of the Edison General Electric Company, and Mr. Daniels electrician of the White House and War and Navy Departments. They are all well known in the electric field.

The Ball & Wood Company's new plant for the manufacture of the improved Ball automatic engines is so far completed that shipments of engines have commenced, and the works have been running night and day since Oct. 1. During the recent meeting of the American Society of Mechanical Engineers in New York, the Ball & Wood Company had the pleasure of entertaining many of the members who took advantage of the proximity of the works to inspect them. Among others, the following orders for the improved Ball engines have already been executed: Two 150-h. p. for the Edison Electric Illuminating Company, of Paterson, N. J.; 75 h. p. for the Saugerties (N. Y.) Electric Light Company; 100-h. p. for the Meriden (Conn.) Electric Light Company; 75-h. p. for the Edison General Electric Company, Rockledge, Fla.; 150-h. p. for the Electric Light Company, Madison, N. J.; 300-h. p. cross compound for the Edison Company, of Paterson, N. J., for street railway service.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse N. Y.

The Novel Basket shown in an illustration on page 446 is for sale. It can be used for an advertising window display, banquet table setting, or any purpose where a novel electrical design is desired. Also a quantity of miniature incandescent lamps, one and two candle power. Address W. T. Knox, 250 Washington street, New York, or 257 South Fifth street, Brooklyn.

The Hine Eliminator Company, of 106 Liberty street, New York, has recently filled orders for its eliminator from the Cedar Rapids (Iowa), Jackson (Mich.) and Battle Creek (Mich.) Electric companies; also for three others to go on to the steam pipes in the electric and mechanical laboratories of the Michigan State University at Ann Arbor. The high efficiency demonstrated by this eliminator in the Cornell steam separator test gives it a place way to the front of all competitors.

The Reliable Manufacturing Company, of 53 State street, Boston, which manufactures a reliable sand box, the Collett ratchet brake and several other electric street car specialties, is putting up a large factory at Everett, Mass. When completed this will give the company facilities for its business which will enable it to fill orders promptly after the first of the year. Some of the largest and best companies in the country are using these appliances and in every instance they are said to be giving the best of satisfaction.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

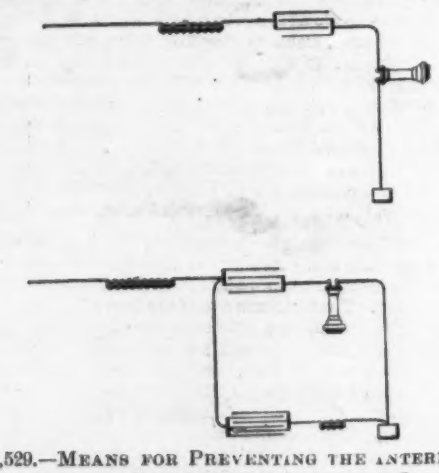
U. S. PATENTS ISSUED DEC. 8, 1891.

461,460. Electric Railway Signal; Charles E. Buzzell, of Leaf River, Ill. Application filed June 20, 1891. The combination of a suitable appliance for actuating a railway switch or signal, a normally closed electrical main circuit in which is included instruments suitable for telegraphic purposes, a battery, and an automatic circuit breaker, an electrical switch in a circuit normally rendering said automatic circuit breaker inoperative, said electrical switch opened and closed by the movement of the actuating appliances.

464,505. Conduit Conductor for Electric Railways; Walter H. Knight, of New York. Application filed Aug. 4, 1888. In a conduit for an electric railway, the combination, with a slot rail, of a sub-structure therefor, a socketed bracket attached to the interior of the said sub structure, an insulator in said socket, and a main supply conductor supported by the insulator.

464,510. Automatic Fire-Alarm Telegraph; Morris Martin, of Malden, Mass., Assignor by mesne assignments to John F. Nielsom, of Elizabeth, N. J. Application filed Feb. 21, 1887. The combination of an electrically connected transmitting instrument and controlling electric circuit therefor, and a circuit changer or switch in the said controlling circuit, having contacts by which it makes a change in said circuit and immediately thereafter restores the same to its original condition, a signal receiving instrument, and transmitting circuit connecting the said receiving instrument with the signaling portion of the transmitting instrument and including as a part of it a portion of the circuit that controls the transmitting instrument and is governed by the transmitter controlling switch, whereby the said transmitting circuit is complete and operative only when said controlling circuit is in normal condition.

464,513. Electric Fare-Recording System; Barton S. Molyneux, of Minneapolis, Minn. Application filed Feb. 28, 1891. The comination, in an electric fare-recording system, of an electric circuit with a suitable recorder or register and a source of



No. 464,529.—MEANS FOR PREVENTING THE INTERFERENCE WITH SPEECH ON TELEPHONE CIRCUITS BY INDUCED OR OTHER CURRENTS.

electricity included in said circuit, electric fair registers carried by the several cars of the street railway system, and means for connecting the same in said circuit at a predetermined point or points along the railway.

464,519. Spring-Jack Switch; Wm. R. Patterson, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed May 27, 1890. This invention consists in the construction of a metallic frame or tube, in combination with a contact spring or lever placed in a vertical plane within the frame, the parts being so arranged that the contacts shall be covered, while at the same time an aperture is provided below them for any dust to fall out that may get within the switch. The frame consists of a socket having projections extending toward the rear of the switchboard, the projection above serving as the shield and the projection below preferably serving as a line connection. A block of insulation is held between the rear ends of these projections, the contact lever being mounted on one side thereof and the contact point, against which the lever is adjusted to normally rest, being mounted on the other side of said block of insulating material. The contact-spring has its free end presented to the opening in the tube, so that when a plug is inserted the lever will be lifted from its contact and closed to the tip of the plug, while the sleeve of the plug will be in contact with the socket or frame. (See illustration.)

464,529. Means for Preventing the Interference with Speech on Telephone Circuits by Induced or Other Currents; William Stanley, Jr., of Pittsfield, Mass., and John F. Kelly, of New York. Application filed May 22, 1891. An electrical signaling system, comprising a circuit and receiving instrument combined therewith, which is responsive to currents of both low and high frequency, the said receiving instrument being placed in a portion of the circuit which is adapted by the adjustment of its self-induction and capacity to oppose the passage of current waves below a certain frequency. (See illustration.)

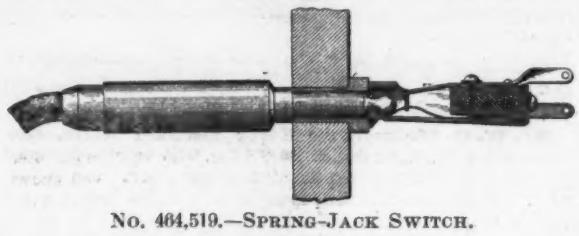
464,540. Time Registering Device for Electrical Currents; William D. Wilder and Walter Cobb, Jr., of Brockton, Mass. Application filed Nov. 13, 1889. The combination, with a switch or other device for making and breaking an electric circuit, of a pivoted spring arm provided with a spring arm, a stop or abutment on a suitable support, a wheel or other moving part of a clock or other operating mechanism, and a registering device.

464,547. Armature Winding for Dynamo Electric Machines; Craig R. Arnold, of Philadelphia, Pa. Application filed March 14, 1885. In a dynamo electric machine or motor, a cylindrical armature having its armature coils or bobbins divided into sections, the separate sections of each coil being wound or disposed in parallel planes, the dividing line of which intersects the armature body or carrier.

464,548. Cut-Out; Craig Ritchie Arnold, of Sharon Hill, Pa. Application filed June 11, 1891. In a fusible cut-out for electric circuits, the combination of an open glass tube having the metal ferrules or rings applied at its ends and a fusible strip or wire within the tube having its ends fastened to said ferrules.

464,557. Electric Railway System; Leon O. Dion, of Natick, Mass. Application filed Dec. 5, 1890. The combination of a car or other vehicle, a storage battery thereon, an elongated conductor or contact on the exterior of the car, extending lengthwise thereof, and consisting of an endless belt and loosely mounted pulleys around which said belt is passed, and electrical connections between one of said pulleys and the battery, whereby when the contact belt touches a distributor of electricity the battery will receive a partial charge.

464,587. Carriage Actuating Mechanism; William H. Phillips, of Jenkintown, Assignor to himself, Archington Gilpin and Paul W. Knauff, of Philadelphia, Pa. Application filed Feb. 2, 1891. The combination, with an electric generator and a circuit leading therefrom, of a switch normally held open, an electromagnet arranged in the circuit to hold the switch closed, a car or its equivalent, a drum carried on said car, a conduit wire wound on said drum and electrically connected with a wire on the car and with the circuit from the generator, a motor carried on the car and geared to drive the same, a switch connected with the wire on the car and with the motor, said switch being adjustable, so as



No. 464,519.—SPRING-JACK SWITCH.

to reverse the current in the motor connection, and gearing actuated by the motor and connected with the switch to break the circuit and reverse the switch after the motor has made a determined number of revolutions.

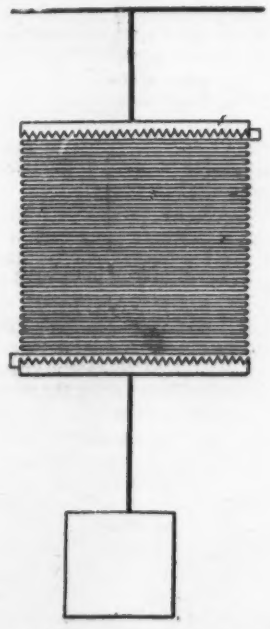
464,595. Lightning Arrester; Elihu Thomson, of Swampscott, Mass. Application filed Oct. 11, 1890. A lightning arrester consisting of an electrically continuous conductor connected to ground, so arranged as to form a series of disruptive insulation spaces between successive portions of the conductor for the discharge to leap consecutively and of a total resistance sufficient to prevent the passage of much of the line current to earth. (See illustration.)

464,643. Protector for Telephones; John L. W. Zietlow, of Arberdeen, S. Dak., Assignor of one-half to Francis A. Burdick, of same place. The combination, with a system of ordinary electrical conductors, such as electric-light circuits, carrying currents of great strength, and a system of conductors, such as telephone wires, carrying currents of less strength, of the grounded connections of the conductors carrying the weaker currents, an inclosing protector of high conductivity surrounding said grounded connections, and a conductor of high conductivity in circuit with a generator and connected with said surrounding protector and provided with ground connections outside the area of the conductors carrying the stronger currents.

464,655. Electric Track Signal; Homer Alton Parrish, of Jackson, Mich., Assignor to the Parrish Electric Track Signal Company, of Detroit, Mich. Application filed March 9, 1891. In an electric track signal, the combination of a rail of the track, the tread bar metal faced on the upper and lower surface, said metal surfaces being connected, said bar being on the outside of the rail and held by a spring resistance against lateral displacement, and the spring bar supporting the said tread bar from beneath and the spring bar below the former named spring bar, said spring bars constituting the circuit controllers.

464,665. Secondary Battery; Isaiah L. Roberts, of Brooklyn, N. Y., Assignor to the Roberts-Brevoort Electrical Company, Limited, of New York. Application filed Dec. 31, 1890. In a secondary or storage battery, the combination of the electrodes with an electrolyte of a salt of iron, which is capable of absorbing an acid radical, and a non-porous electrolytic diaphragm interposed between the electrodes.

464,666. Electromagnetic Motor; Nikola Tesla, of New York. Application filed July 13, 1891. In an alternating current motor provided with two or more energizing or field circuits, one of which is adapted for connection with a source of currents and the other or others, in inductive relation thereto, the combination with the secondary or induced circuit or circuits of a condenser interposed in the same. (See illustration.)



No. 464,595.—LIGHTNING ARRESTER.

464,667. Electrical Condenser; Nikola Tesla, of New York. Application filed Aug. 1, 1891. An electrical condenser composed of plates or armatures adjustable with respect to one another and immersed in oil.

464,671. Transformer-Motor; Otto Titus Bláthy, of Buda-Pesth, Austria-Hungary. Application filed Nov. 8, 1889. A transformer-motor for alternate currents, consisting of two field-magnets or groups thereof adapted to receive alternating currents of different phases, in combination with an armature provided with closed coils having one part distorted with reference to the other

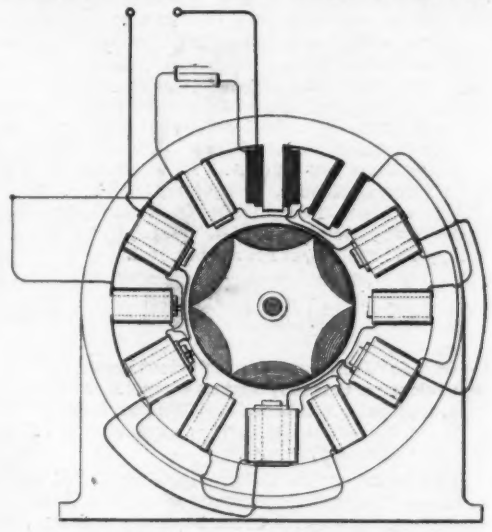
464,676. Electrode for Secondary Batteries; William Morrison, of Des Moines, Ia., Assignor to the Hess Electric Storage Battery Company, of same place. Application filed Oct. 27, 1890. An electrode for secondary batteries, consisting of a stratum or body portion of active material or material to become active, and a layer, coating or covering of fibrous glass-wool disposed upon the face or side of the body portion of active material, and perforated confining non-conducting plates of a material not subject to the action of the electricity or solution holding said glass-wool upon the face of the active material.

464,677. Electrical Transformer; Arcadius Poleschko, of St. Petersburg, Russia. Application filed April 17, 1891. An electrical transformer having a core of spaced iron plates provided with a vertical slot within the core containing the primary coils, and a slot extending substantially at right angles to the first-named slot and containing the secondary coils.

464,682. Electric Arc Lamp; Addison G. Waterhouse, of Hartford, Conn. Application filed April 1, 1891. An electric arc lamp frame having insulating cement into which the terminal plate is imbedded, said cement having an annular recess around the carbon rod and supported in its place by adhering to the inner surface of the lamp.

464,683. Electric Meter; Addison G. Waterhouse, of Hartford, Conn. Application filed April 10, 1891. The combination, in an electrical meter, of a vessel adapted to hold a fluid electrolyte provided with electrodes, a gas collector placed over one or both of said electrodes, said collector being provided with a tube or gas passage leading from the upper interior of the gas collector, having the elements within itself for discharging the gas from the collector after a certain amount has been collected.

464,691. Electric Body Wear; Lauritz Anderson, of Chicago, Ill. Application filed March 16, 1891. An electric body appliance comprising a pad having a pocket, a battery located within said pocket, loops pivoted to the end portions of said pad and adapted to swing over and embrace the end portions of said



No. 464,666.—ELECTROMAGNETIC MOTOR.

pocket, and a plurality of flexible cords electrically connected with said battery.

464,719. Incandescent Lamp Filament; Ludwig K. Böhm, of New York. Application filed Jan. 2, 1890. The process of making filaments for incandescent lamps, consisting of impregnating carbonizable material with carbonates of calcium or magnesium and carbonizing the same, whereby a filament is produced composed of carbon and oxide of calcium or magnesium.

464,770. Clamp for Electric Wires; John Jay Green, of Boonton, and George C Brown, of Elizabeth, N. J. Application filed Oct. 30, 1890. In a wire clamp, the combination of a base having an inclined bearing surface, a rotatable cap, having a similar and opposed inclined surface, and loosely encircling a central pin capable of longitudinal adjustment, and a groove for receiving the wire.

464,780. Trolley for Electric Railways; John W. Schlosser, of Washington, D. C. Application filed Aug. 10, 1891. A vertically swinging trolley jointed to permit independent falling motion of its upper end, in combination with automatic trip devices, whereby the parts are held in fixed relations until the arm rises above the upper limit.

464,816. Ore Separator; William G. Conkling, of Glens Falls, N. Y. Application filed Sept. 19, 1889. A magnetic ore separator having a pair of inclined aprons secured directly to and depending from the sides of the frame, with their lower edges located between the two longitudinal edges of an endless imperforated belt, the aprons running parallel with the upper moving surface of the belt and curved inward toward each other across the belt and within the field of the magnets.

464,822. System of Distributing Electricity; Thomas A. Edison, of Menlo Park, N. J., Assignor to the Edison Electric Light Company, of New York. Application filed June 26, 1882. In a system of electrical distribution, the combination of a main circuit extending to a distance from the source of electrical energy and having a current of high tension, a constantly acting tension reducer, connected with such main circuit by a multiple arc or cross circuit, so as to be independent of other similarly connected tension reducers, and a translation circuit supplied by such tension reducer with a current of lower tension.

464,897. Telegraph-Key; Louis F. Robare, of Au Sable Forks, N. Y. Application filed June 4, 1891. The combination with the base, of two pillars having vertical and transverse apertures, screws extending down through the vertical apertures into the transverse apertures to bind the wires, one of said screws and its binding post being insulated, a key journaled to the said pillars and having contacts and a plate connecting one of the contacts and the insulated binding post.

464,948. Automatic Cut-Out for Electric Motors; Schuyler S. Wheeler, of New York. Application filed July 16, 1887. A cut-out for electromotors, consisting of a normally open low-resistance shunt, a high-resistance shunt including the coils of a solenoid, a contact arm connected to the solenoid, means for adjusting the contact arm, and a spring connected to the arm, so that it will normally hold it away from the solenoid when the arm is moved.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.